Naval Research Laboratory
Stennis Space Center, MS 39529-5004

NRL/MR/7440--03-8717

Mapping, Charting, and Geodesy Branch
Abstracts of Publications, 2000-2002

MICHAEL M. HARRIS
DIANNE M. JAMES

Mapping, Charting, and Geodesy Branch
Marine Geosciences Division

November 28, 2003

20031217 226

Approved for public release; distribution is unlimited.

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing this collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports (0704-0188), 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number. **PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.**

1. REPORT DATE *(DD-MM-YYYY)*	2. REPORT TYPE	3. DATES COVERED *(From - To)*
November 28, 2003	Memorandum Report	1 January 2000 to 31 December 2002

4. TITLE AND SUBTITLE

Mapping, Charting, and Geodesy Branch
Abstracts of Publications, 2000-2002

5a. CONTRACT NUMBER

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER
0603207N

6. AUTHOR(S)

Michael M. Harris and Dianne M. James

5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER
74-7441-A3

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

Naval Research Laboratory
Marine Geoscience Division
Stennis Space Center, MS 39529-5004

8. PERFORMING ORGANIZATION REPORT NUMBER

NRL/MR/7440--03-8717

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)

SPAWAR PMW 150
4301 Pacific Highway
San Diego, CA 92110

10. SPONSOR / MONITOR'S ACRONYM(S)
SPAWAR

11. SPONSOR / MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION / AVAILABILITY STATEMENT

Approved for public release; distribution is unlimited.

13. SUPPLEMENTARY NOTES

14. ABSTRACT

This document contains abstracts from publications written by the Naval Research Laboratory's Mapping, Charting, and Geodesy (MC&G) Branch during the period 1 January 2000 to 31 December 2002. During that time period, the MC&G Branch published 11 chapters in books, 28 journal articles, and 26 NRL reports. The majority of the abstracts (83) are from conference proceedings. A video, 6 web pages, and 19 abstracts were also published. Abstracts from 5 patents awarded by the United States Patent and Trademark Office are also included.

Indexes by author and type of publication are at the beginning of the report followed by a list of acronyms and the actual abstracts. The abstracts are listed in alphabetical order by first author. In cases where the first author was from another organization, they are sorted by first MC&G Branch author listed.

15. SUBJECT TERMS

Publications

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			Michael M. Harris
Unclassified	Unclassified	Unclassified	UL	208	19b. TELEPHONE NUMBER *(include area code)* 228-688-4420

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std. Z39.18

CONTENTS

1. INTRODUCTION iv

2. INDEXES v

   2.1 Author Index v
   2.2 Book Chapters viii
   2.3 Journal Articles ix
   2.4 NRL Formal Reports xi
   2.5 NRL Memorandum Reports xii
   2.6 Conference Proceedings xiv
   2.7 Abstracts xxi
   2.8 Videos xxiii
   2.9 NRL Web Pages xxiii
   2.10 Patents xxiv

3. LIST OF ACRONYMS xxv

4. ABSTRACTS (Alphabetical by First MC&G Author) 1-179

5. ACKNOWLEDGEMENTS 180

1. INTRODUCTION

This document contains abstracts from publications written by the Naval Research Laboratory s Mapping Charting and Geodesy (MC&G) Branch during the period, 1 January 2000 to 31 December 2002. During that time period the MC&G Branch published 11 chapters in books, 28 journal articles, and 26 NRL reports. The majority of the abstracts (83) are from conference proceedings. A video, 6 web pages, and 19 abstracts were also published. Abstracts from 5 patents awarded by the United States Patent and Trademark Office are also included.

Indexes by author and type of publication are at the beginning of the report followed by a list of acronyms and the actual abstracts. The abstracts are listed in alphabetical order by first author. In cases where the first author was from another organization, they are sorted by first MC&G Branch author listed.

Manuscript approved November 3, 2003.

2. INDEXES

2.1 AUTHOR / INDEX

Abdelguerfi, M. 56, 97, 98, 99, 102, 104, 162, 178
Ali, D. 143, 161
Alleman, P. 25
Angryk, R. 143
Avera, W. . 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 24, 30, 72, 73, 74, ... 75, 77
Baribault, C. 121
Beaubouef, T. 42, 48, 49, 142
Beckman, R. 18, 19, 20, 21
Benjamin, K. 96
Bentrem, F. 22, 23, 24, 158
Bibee, L. 1, 3, 10, 11, 14, 30, 73, 74, 75, 77
Birkemeier, W. 92, 144
Bourgeois, B... 15, 18, 19, 20, 21, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, ... 38, 39, 68, 122, 123, 124, 134, 135, 136
Brandon, D. 39
Braud, J. 120, 164, 168
Bravley, J. 25
Breazeale, M. 61
Breckenridge, J. ..... 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 55, 97, 99, ... 121, 127, 128, 129, 131, 132
Carter, S. 41, 44, 51, 121, 125, 126, 127, 128, 129, 130, 131, 132, 133
Chahine, G. 59, 60
Chase, H. 16
Chen, J. 124
Cheramie, J. 25, 123
Chung, M. 52, 53, 54, 55, 56, 57, 177
Cobb, M. 41, 56, 57, 143, 159, 161, 163, 178
Cohan, T. 115
Collins, C. 107
Curtis, W. 87
Dale, J. 53
DelBalzo, D. 7, 13
Dugan, J. 83, 84, 91
Duncan, M. 23
Edwards, S. 58, 63, 64, 107, 108, 109, 111, 113, 137, 139, 171
Elmore, P. 59, 60, 61
Farquharson, G. 150
Faust, N. 41
Flattem, E. 62
Foley, H. 163

Frasier, S. J. 150
Freilich, M. 144, 149
Gendron, M. 58, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 110, 111, 113, 117, 122,
.....137, 138, 139, 140, 169, 171, 174
Givaudan, J. 162
Goss, H. 41
Gravley, J. 123
Griffin, S 96
Hammack, J. 70, 71
Hanes, D. 88
Harris, M. 2, 6, 10, 11, 14, 28, 30, 43, 72, 73, 74, 75, 76, 77, 78, 79, 80, 125
Hathaway, K. 87
Higgins, M. 41
Holland, K. T..30, 40, 53, 78, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94,
.....95, 145, 146, 147, 150, 151, 152, 153, 154, 155, 156, 157
Holman, R. 81, 94, 144, 149
Horton, J. 2
Ioup, J. 67, 68, 69, 117
Ioup, G. 68
Iyengar, S. 122
James, D 76
Kaihatu, J. 86
Kalcic, M. 23, 62, 96
Karam, O. 160
Killingsworth, K. 12
Kinney, W. 1, 5, 12
Kissling, G. 119
Klos, L. 98
Koehler, K. 168
Kooney, T. 3, 17, 90, 94, 151, 157
Ladner, R....40, 52, 54, 55, 56, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 121,
.....141, 162, 177, 178
Lambert, D. 96
Landrum, J. 167
Lea, S. 118, 119
Lingsch, S. 10, 11, 30
Liu, B. 98
Lohrenz, M. 63, 65, 67, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117,
.....137, 139, 140, 169, 170, 173, 174
Lovitt, T. 41, 44, 56, 121, 178
Lybanon, M. 118, 119
Mang, R. 3, 58, 64, 111
Martinez, A. 18, 19, 20, 21, 25, 28, 31, 38, 62, 135, 136
McCreedy, F. 50, 55, 97, 99, 120, 121, 141, 177, 178
McDowell, P. 37, 122, 123, 124

McMurray, LT. M. 116
Mehaffey, J. 65, 110
Mesick, H. 41, 44, 51, 121, 125, 126, 127, 128, 129, 130, 131, 132, 133, 166
Mobbs, J. 1
Moreau, C. 167
Morgan, L. 134, 135, 136
Mozley, E. 3, 4, 5
Myers, L. 134, 135, 136
Myrick, S. .63, 64, 66, 108, 110, 111, 113, 115, 116, 117, 137, 138, 139, 140, 169, ... 171, 172, 174
Nelson, J. 9, 13, 16
Null, J. M. 74, 75
O'Dell, T. 119
Oguz, H. 59, 60
Olivier, D. 121, 141, 178
Paprzycki, M. 143
Perniciaro, R. 50
Petry, F. 41, 49, 57, 101, 103, 105, 142, 143, 160, 161, 163, 178
Piotrowski, C. 84, 91
Plant, N. 81, 86, 144, 145, 146, 147, 148, 149, 155
Puleo, J. 86, 88, 90, 93, 94, 145, 150, 151, 152, 153, 154, 155, 156, 157
Rahimi, S. 143, 161
Raubenheimer, B. 150
Rayner, L. 96
Reed, C. 53
Reynaud, J. 3
Richard III, G. G. 98
Riedlinger, L. 65
Ruffner, J. 112, 115
Sallenger, A. 154
Sample, D. 96
Sample, J. 10, 11, 22, 23, 24, 30, 106, 122, 158
Sanders, W. 11, 12
Seabergh, W. 87
Seldenright, V. 72
Shaw, K. ..... 40, 41, 44, 45, 50, 51, 52, 53, 54, 55, 56, 57, 78, 97, 98, 99, 100, 102, ... 104, 106, 120, 121, 127, 131, 159, 160, 161, 162, 163, 177, 178
Showalter, J. 1, 12
Slinn, D. 88, 152, 156
Stanley, J. 94
Steed, C. 164, 165, 166, 167, 168
Thomas, M. 41
Trenchard, M. 51, 58, 63, 65, 66, 107, 108, 109, 110, 111, 112, 113, 114, 115, 117, ... 138, 169, 170, 171, 172, 173, 174, 175, 176
Wagstaff, R. 1

Waring, LCDR 176
Watkins, J. 140
Webb, B. 152
Wen, L. 143
Williams, J. 83, 84, 91
Wilson, R. 40, 52, 53, 54, 55, 56, 57, 97, 99, 120, 121, 126, 130, 131, 141, 177, 178
Wischow, P. 65, 110, 179
Yang, H. 143, 159, 161

2.2 BOOK CHAPTERS

Beaubouef, T., Petry, F. and **Breckenridge, J.;** Rough Set Based Uncertainty Management For Spatial Databases And Geographical Information Systems. Published Book Chapter in March 2000.

Chung, M., Ladner, R., Wilson, R. Breckenridge, J., and Shaw, K.; Adding The Third Dimension To Digital Mapping. Published Book Chapter in the Kluwer, April 2001. NRL/BA/7440-00-1002.

Chung, M., Wilson, R., Ladner, R., Shaw, K., Lovitt, T., Cobb, M., and Abdelguerfi, M.; The Geospatial Information Distribution System (GIDS) For 2D And Full 3D Topology Mapping. Published Book Chapter in October 2000. NRL/BA/7441-00-0001.

Cobb, M., Foley, H., Petry, F. and **Shaw, K.;** Uncertainty In Distributed and Interoperable Spatial Information Systems. Published Book Chapter in Recent Issues On Fuzzy Databases in December 2000.

Ladner, R. and Shaw, K.; An Overview Of 3D Synthetic Environment Construction. Published Book Chapter in the Kluwer, 2001. NRL/BA/7440-00-1001.

Ladner, R., Shaw, K. and Abdelguerfi, M.; Mining Spatio-Temporal Information Systems Published Book, August 2002. NRL/BO/7440—02-1001.

Ladner, R. and Petry, F.; Spatio-Temporal Data Mining And Knowledge Discovery: Issues Overview. Published Book Chapter in the Mining Spatio-Temporal Information Systems Book, July 2002. NRL/BC/7440—02-1003.

Lea, S. and **Lybanon, M.;** Shoaling Waves Simulator. Published in the Encyclopedia Of Computer Science And Technology, June 2000.

Olivier, D., Ladner, R., McCreedy, F. and Wilson, R.; Efficient Storage Of Large Volume Spatial And Temporal Point-Data In An Object-Oriented Database. Published Book Chapter in the Kluwer, July 2002. NRL/BC/7440—02-1001.

Petry, F.; Cobb, M., Ali, D., Angryk, R., Paprzycki, M., Rahimi, S., Wen, L. and Yang, H.; Fuzzy Spatial Relationships And Mobile Agent Technology In Geospatial Information Systems. Published Book Chapter in Applying Soft Computing In Defining Spatial Relations Book in October 2002. NRL/BA/7440-01-1001.

Wilson, R., Cobb, M., McCreedy, F., Ladner, R., Olivier, D., Lovitt, T., Shaw, K., Petry, F. and Abdelguerfi, M.; Geographical Data Interchange Using XML-Enabled Technology Within The GIDB™ System. Published Book Chapter in XML Book Edited by Akmal Chandhri in 4th Quarter in 2002. NRL/BC/7440—02-1002.

2.3 JOURNAL ARTICLES

Avera, W., Kooney, T., Bibee, L., Mang, R., Mozley, E. and Reynaud, J.; A New Electrically Isolated Towed Electric Field Source For Oceanographic Surveys. Published in *The Sea Technology Publication*, February 2000. NRL/JA/7442-99-0014.

Avera, W., Mozley, E. and Kinney, W.; Development Of An Electrical Conductivity Model With Application To A Submarine Extremely Low Frequency Electric Signature (U). Published in *The Journal of Underwater Acoustics*, July 2000.

Avera, W., Harris, M., Bibee, L., Sample, J. and Lingsch, S.; Multibeam Bathymetry From A Mine-Hunting Military Sonar. Published in the *Journal of the Society for Counter-Ordnance Technology*, May 27, 2002. NRL/JA/7440—02-1010.

Avera, W., Nelson, J. and Chase, H.; VP-08 Environmental MAD Survey Of The Bay Of Fundy. Published in the *Journal of Underwater Acoustics*, August 2002. NRL/JA/7440—02-1005.

Beaubouef, T. and **Breckenridge, J.**; Real-World Issues And Applications For Real-Time Geographic Information Systems (RT-GIS). Published in the *Journal of Navigation*, January 2000. NRL/PP/7441-99-0007.

Birkemeier, W. and **Holland, K. T.**; The Corps of Engineers' Field Research Facility: More Than Two Decades Of Coastal Research. Published in the *Shore and Beach*, March 2001. NRL/JA/7440-01-1001.

Breckenridge, J. and Beaubouef, T.; Expanding The Navy's Geospatial Information Data Base (GIDB) In Support Of Hydrographic Survey Operations. Published in the *Journal of Integrated Coastal Zone Management*, March 2000 Edition. NRL/JA/7440-00-0001.

Chung, M., Wilson, R., Ladner, R. and Shaw, K.; Geospatial Information Database In Support Of Urban Warrior Exercise. Published in the *NRL Review*, June 2000. NRL/PU/5211-00-399.

Chung, M., Wilson, R., Shaw, K., Petry, F. and Cobb, M.; Querying Multiple Data Sources Via An Object-Oriented Spatial Query Interface And Framework. Published in the Special Issue of the *Journal of Visual Languages and Computing*, 2001. NRL/JA/7441-00-0018.

Elmore, P., Chahine, G. and Oguz, H.; Cavity And Flow Measurements Of Reproducible Bubble Entrainment Following Drop Impacts. Published in the *Journal of Experiments In Fluids*, December 2001. NRL/JA/7440-01-1005.

Elmore, P. and Breazeale, M.; Dispersion And Frequency Dependent Nonlinearity Parameters In A Graphite-Epoxy Composite. Published in the *Journal of the Acoustical Society of America*, 2001. NRL/JA/7440-01-1006.

Gendron, M. and Ioup, J.; Wavelet Multi-Scale Edge Detection For Extraction Of Geographic Features To Improve Vector Map Databases. Published in the *Journal of Navigation*, January 2000. NRL/PU/7440-00-0347.

Harris, M., Avera, W., Bibee, L. and Null. M.; Environmental Data Collection From The AQS-20. Published in the *Journal of the Society for Counter-Ordnance Technology*, May 27, 2002. NRL/JA/7440—02-1009.

Holland, K. T.; Application Of The Linear Dispersion Relation With Respect To Depth Inversion Using Remotely Sensed Imagery. Published in the *IEEE Journal of Geoscience and Remote Sensing*, January 2001. NRL/JA/7442-00-0017.

Holland, K. T., Puleo, J. and Kooney, T.; Quantification Of Swash Flows Using Video-Based Particle Image Velocimetry. Published in the *Coastal Engineering*, January 2001. NRL/JA/7440-00-0026.

Holland, K. T. and Puleo, J.; Variable Swash Motions Associated With Foreshore Profile Change. Published in the *Journal of Geophysical Research*, 2001. NRL/JA/7442-99-0019.

Ioup, J., **Gendron, M.** and Lohrenz, M.; Vector Map Data Compression With Wavelets. Presented to the *Journal of Navigation*, September 2000.

Kinney, W., **Avera, W.,** Showalter, J., Sanders, W. and Killingsworth, K.; Sensitivity Of Probability Of Detection To Variations In Environmental Parameters For Multisensor Systems (U). Published in the *Journal Of Underwater Acoustics*, July 2000.

Ladner, R., Shaw, K. and Abdelguerfi, M.; 3D Mapping Of An Interactive Synthetic Environment. Published in the *IEEE Computer*, March 2000.

Lohrenz, M., Myrick, S., Trenchard, M., Ruffner, J. and Cohan, T.; Pilot Preferences On Vector Moving-Map Displays. Published in the *Journal of Navigation*, January 2000. NRL/JA/7440-00-0002.

Plant, N., Holman, R., Freilich, R. and Birkemeier, W.; A Simple Model For Interannual Sandbar Behavior. Published in the *Journal of Geophysical Research*, July 15, 1999. NRL/JA/7440—02-1001.

Plant, N., Holland, K. T. and Puleo, J.; Analysis Of The Scale Of Errors In Nearshore Bathymetric Data. Published in the *Marine Geology*, August 7, 2002. NRL/JA/7440—01-1002.

Plant, N., Freilich, M. and Holman, R.; Role Of Morphologic Feedback In Surfzone Sandbar Response. Published in the Journal of Geophysical Research, January 15, 2001. NRL/JA/7440—02-1002.

Puleo, J., Holland, K. T. and Kooney, T.; A Video-Based Particle Image Veloimetry (PIV) Technique For Nearshore Flows. Published in the *Naval Research Laboratory 2001 Review*, April 2001.

Puleo, J. and Holland, K. T.; Estimating Swash Zone Friction Coefficients On A Sandy Beach. Published in the *Coastal Engineering*, April 2000. NRL/JA/7442-00-0009.

Ruffner, J., **Lohrenz, M.** and Trenchard, M.; Human Factors Issues In Advanced Moving-Map Systems. Published in the *Journal of Navigation*, January 2000. NRL/JA/7441-99-0023.

Wagstaff, R., Kinney, **Avera, W.,** Mobbs, J., Showalter, J. and Bibee, L.; Acoustic Verification Of Nonacoustic Detection Using Fluctuation-Based Processing (U). Published in *The Journal of Underwater Acoustics*, July 2000.

Wischow, P.; Lossless Image Compression With Intelligent Algorithm Selection. Published *Thesis* at the University of South Alabama, May 2001.

2.4 NRL FORMAL REPORTS

Harris, M., Avera, W. and Bibee, L.; Environmental Data Acquisition From The AQS-20 Mine Hunting Sonar Requirements, Technical Feasibility And Cost. Published as NRL/FR/7440—02-10002, May 15, 2002.

Lohrenz, M., Gendron, M., Myrick, S., Mehaffey, J., Trenchard, M. and Wischow, P.; AV-8B Map System II: Moving-Map Composer Version 3.3 Software Users' Manual (2nd Edition). Published as NRL/FR/7440-00-9938, June 30, 2000.

Nelson, J., and **Avera, W.**; Magnetic Detection In The High Arctic Barents Sea (U). Published as NRL/FR/7440-00-9967, March 2001.

Steed, C. and Braud, J.; A Flat-Earth System For DBDB-V. Published as NRL/FR/7440—02-10,025, August 13, 2002.

Steed, C., Landrum, J. and Moreau, C.; PUMA/TEDS Technical Execution Plan. Published as NRL/FR/7440—02-10,003, June 13, 2002.

Trenchard, M. and Lohrenz, L.; Critical Issues Concerning Digital Map Processing For The AN/ASQ-196 Digital Map System. Published as NRL/FR/7440-00-9942, January 7, 2000.

2.5 NRL MEMORANDUM REPORTS

Avera, W. and Harris, M.; Environmental Requirements For Through The Sensors Support Of Mine Warfare. Published as NRL/MR/7440-00-8236, March 13, 2000.

Avera, W. and Bourgeois, B.; Utilization Of Magnetic Models To Improve Magnetic Micro-Navigation. Published as NRL/MR/7440-00-8237, March 13, 2000.

Breckenridge, J., Mesick, H., Carter, S., and Shaw, K.; Digital Mapping, Charting, and Geodesy Analysis Program Technical Review Of Tactical Ocean Data (TOD) Levels 0, 1, 2. Published as NRL/MR/7440—02-8281, September 30, 2002.

Breckenridge, J., Carter, S., Mesick, H., Trenchard, M. and Shaw, K.; DMAP Technical Review DLA Electronic Catalog of NIMA Products Prototype 1. Published as NRL/MR/7440-01-8257, February 22, 2001.

Breckenridge, J., Mesick, H., Carter, S., Shaw, K., and Lovitt, T.; National Implementation Plan - LEA IT Census Phase I of the Database for Assessment of Requirements and Tactics (DART). Published as NRL/MR/7440-01-8267, September 14, 2001.

Breckenridge, J., McCreedy, F., Shaw, K. and Perniciaro, R.; The Database For The Assessment Of Requirements And Tactics (DART) Phase I. Published as NRL/MR/7440-00-8246, September 29, 2000.

Carter, S., Mesick, H., Breckenridge, J. Trenchard, M., and Shaw, K.; Digital Mapping, Charting, and Geodesy Analysis Program: Technical Review DLA Electronic Catalog of NIMA Products Prototype 1. Published as NRL/MR/7440-01-8257, February 22, 2001.

Gendron, M., Myrick, S., Edwards, S. and Mang, R.; Demonstrating A Moving-Map System With Electronic Charts For Improved Lane Navigation: Testing On AAVs In Gulfport, MS. Published as NRL/MR/7440—02-8280, September 30, 2002.

Lambert, D., **Kalcic, M.,** Griffin, S., Rayner, L. Benjamin, K. and Sample, D.; Final Report for the TRIFOCAL Sensor Technology Development Project. Published as NRL/MR/7431—01-8259, July 31, 2001.

McCreedy, F., Ladner, R., Wilson, R., Breckenridge, J., Carter, S., Mesick, H., Olivier, D., Shaw, K., Baribault, C. and Lovitt, T.; System Documentation For The Geospatial Information Database (GIDB™) System Server Version 2.0. Published as NRL/MR/7440—02-8275, June 24, 2002.

Mesick, H., Carter, S., and Harris, M.; Digital Mapping, Charting, and Geodesy Analysis Program Spatial And Temporal Reference Systems And The 4D3 Concept. Published as NRL/MR/7440—02-8282, September 30, 2002.

Mesick, H., Carter, S., and Breckenridge, J.; Digital Mapping, Charting, and Geodesy Analysis Program: Technical Review of Additional Military Layers (AML) Draft Product Specification For NATO Review, Edition 2.0. Published as NRL/MR/7440-01-8260, March 9, 2001.

Mesick, H., Carter, S., and Wilson, R.; Digital Mapping, Charting, and Geodesy Analysis Program Technical Review Of Consolidated Vector Product Format Specifications And Related Documents. Published as NRL/MR/7440—02-8284, September 30, 2002.

Mesick, H. and Carter, S.; Digital Mapping, Charting, and Geodesy Analysis Program: Technical Review of MATT Performance Specification. Published as NRL/MR/7440-01-8261, March 9, 2001.

Mesick, H., Breckenridge, J. and Carter, S.; DMAP Technical Review of Additional Military Layers Product Specifications, Ed. 4.0. Published as NRL/MR/7440-02-8276, June 28, 2002.

Mesick, H., Carter, S. and Breckenridge, J.; DMAP Technical Review of Proposed Objects for AML. Published as NRL/MR/7440-01-8269, September 28, 2001.

Mesick, H., Carter, S. and Wilson, R.; DMAP Technical Review of Tactical Oceanographic Data Level 4 (TOD4) Associated Performance Specification, MIL-PRF-89049/14 (15 March 2001). Published as NRL/MR/7440-02-8277, June 28, 2002.

Mesick, H., Carter, S., Breckenridge, J., Wilson, R. and Shaw, K.; DMAP Technical Review of Vector Data Update (VDU) Layer. Published as NRL/MR/7440—02-8291, December 10, 2002.

Trenchard, M. and Lohrenz, M.; Map Requirements Crosswalk From MMC To PFPS/JMPS. Published as NRL/MR/7440-00-8238, March 20, 2000.

Trenchard, M., Lohrenz, M., Gendron, M. and Myrick, S.; Moving-Map Composers System Version 3.4P Acceptance Test Procedures. Published as NRL/MR/7440—02-8279, July 29, 2002.

2.6 CONFERENCE PROCEEDINGS

Avera, W. and Harris, M.; Acquiring Bathymetry Data With The AQS-20 Mine Hunting System. Presented at the 4th International Symposium on Technology and the Mine Problem, March 12-16, 2000. NRL/PP/7442–00-0004.

Avera, W. and Mozley, E.; Bathymetry and Bottom Electrical Properties From An Airborne Electromagnetic Survey At Kings Bay Georgia. Presented at the MARELEC Marine & Electromagnetics Conference & Exhibition 2001, Stockholme, Sweden, July 11-13, 2001. NRL/PP/7440–00-1014.

Avera, W.; Magnetic And EM Projects Overview. Presented at the Japanese Defense Agency Delegates Brief, Washington, DC., April 2, 2002. NRL/OP/7440—02-1006.

Avera, W., Harris, M., Bibee, L., Sample, J. and Lingsch, S.; Multibeam Bathymetry From A Mine-Hunting Military Sonar. Published in the 5th International Symposium on Technology And The Mine Problem Journal, April 21-25, 2002. NRL/PP/7440—02-1020.

Avera, W., Harris, M. and Bibee, L.; Through-The-Sensors Concept To Refresh The Environmental Picture. Presented at the NDIA Conference, San Diego, CA., March 18-22, 2002. NRL/OP/7440—02-1010.

Beaubouef, T. and **Petry, F.;** A Rough Set Foundation For Spatial Data Mining Involving Vague Regions. Presented at the FUZZ IEEE 2002 Conference, Honolulu, Hawaii, May 11-16, 2002. NRL/PP/7440—02-1002.

Beckman, R., Bourgeois, B. and Martinez, A.; AUV Positioning Using Bathymetry Matching. Presented at the IEEE Oceans 2000 Conference, September 11-14, 2000. NRL/PP/7442–00-0011.

Beckman, R., Martinez, A. and Bourgeois, B.; LOST2: A Terrain Based Underwater Positioning System Results From Sea Trials. Presented at the UUST 2001 International Symposium in Durham, NC., August 27-29, 2001. NRL/PP/7440–01-1010.

Beckman, R., Martinez, A. and Bourgeois, B.; LOST2: Results From GOATS 2000. Presented at the GOATS 2000 JPR Conference in La Spezia, Italy on August 21-23, 2001. NRL/PP/7440–01-1009.

Bentrem, F., Sample, J., Kalcic, M. and Duncan, M.; High-Frequency Acoustic Sediment Classification In Shallow Water. Presented at the Oceans 2002 Conference and Exhibition, Biloxi, MS., October 29-31, 2002. NRL/PP/7440—02-1013.

Bourgeois, B.; Autosurvey Software System. Presented at Technology Transfer Exhibits. Various dates 2000-2002. 1004/002G.

Bourgeois, B.; Depthimeter. Presented at Technology Transfer Exhibits. Various dates 2000-2002. 1004/011G.

Bourgeois, B.; Localization Of A Submerged Towed Body (LOST). Presented at Technology Transfer Exhibits. Various dates 2000-2002. 1004/010G.

Bourgeois, B.; Naval Research Laboratory Briefing to ADM Sobral. Presented at the Naval Research Laboratory brief at Stennis Space Center, MS., on March 12, 2002. NRL/OP/7440—02-1004.

Bourgeois, B.; Shipboard Wave Measurement System (SWMS). Presented at Technology Transfer Exhibits. Various dates 2000-2002. 1004/009G.

Bourgeois, B.; Shipboard Wave Measurement System (SWMS). Presented to the National Research Council Canada, December 31, 2001. NRL/OP/7440—01-1010.

Bourgeois, B.; UUV Task Force PNT (Position, Navigation and Timing). Presented at the NAVSEA Seminar, Washington, DC., June 18, 2002. NRL/OP/7440—02-1011.

Bourgeois, B.; UUV Navigation. Presented at the TTCP Technical Panel 13 Meeting at Stennis Space Center, MS., on October 24, 2001. NRL/OP/7440—01-1009.

Bourgeois, B.; UUV Teams For Deep Water Operations. Presented at the Underwater Intervention 2002 Conference, New Orleans, LA., February 28, 2002. NRL/OP/7440—02-1002.

Bourgeois, B. and McDowell, P.; UUV Teams For Deep Water Operations. Presented at the Underwater Intervention 2002 Conference, New Orleans, LA., February 27-March 2, 2002. NRL/PP/7440—01-1015.

Brandon, D. and Bourgeois, B.; AutoSurvey: Current Integration And The AutoSurvey Planner. Presented at the Oceans 2002 Conference and Exhibition, Biloxi, MS., October 29-31, 2002. NRL/PP/7440—02-1024.

Breckenridge, J., Shaw, K., Ladner, R., Wilson, R. and Holland, K. T.; Characterization Of The Dynamic Littoral Zone An Exercise In The Real-Time Dynamics Of Spatial Data Integration. Presented at the Southern Conference on Computing, Hattiesburg, MS., October 26-28, 2000. NRL/PP/7440-00-1013.

Breckenridge, J., Mesick, H., Carter, S., Shaw, K., Cobb, M., Petry, F., Lovitt, T., Thomas, M., Goss, H., Higgins, M. and Faust, N.; Draft - Concepts Of Operation For The CD-GRASS GIS Team. Presented to the National Guard CD-GRASS GIS Team, June 7, 2001. NRL/PO/7440-01-1001.

Breckenridge, J. and Harris, M.; GIS Day 2002 – What is GIS? Presented at the GIS Conference, Ellisville, MS., November 20, 2002. NRL/PT/7440—02-1004.

Breckenridge, J. and Shaw, K.; Naval DMAP GIDB Postal System. Presented at the Oceans 2002 Conference and Exhibition, Biloxi, MS., October 29-31, 2002. NRL/PT/7440—02-1001.

Breckenridge, J.; Naval Research Laboratory-Stennis Space Center Support To National Guard Bureau-CounterDrug Directorate. Presented at the National Guard GIS Technology Symposium, April 27, 2000. NRL/OP/7440-00-0005.

Breckenridge, J.; NGB-CD Technology Program. Presented at the Counter Drug Coordinator Conference, Orlando, FL., March 26-29, 2001.

Chung, M., Shaw, K., Wilson, R., Ladner, R., Breckenridge, J., and McCreedy, F.; Mine Warfare Technical Article, Summer 2000.

Curtis, W., Hathaway, K., Seabergh, W., and **Holland, K. T.;** Measurement Of Physical Model Wave Diffraction Patterns Using Video. Presented at the 4th International Symposium On Wave Measurement and Analysis, San Francisco, CA., September 3-5, 2001. NRL/PP/7440-00-1005.

Dugan, J., Piotrowski, C., Williams, Z., and **Holland, K. T.;** Space-Time Imaging Of Shoaling Waves And Surf. Presented at the 4th International Symposium On Wave Measurement and Analysis, San Francisco, CA., September 3-5, 2001. NRL/PP/7440-00-1006.

Edwards, S., Gendron, M., Mang, R. and Trenchard, M.; Military Application Of Commercial Navigation Products. Presented at the ION GPS 2002 Conference, Portland, Oregon, September 24-27, 2002. NRL/PP/7440—02-1001.

Flattem, E., Kalcic, M. and Martinez, A.; Object Detection In Oceanic Sediments Using Quadratic Detectors And Wavelets. Presented at the Underwater Intervention 2001 Conference, Tampa, FL., January 2001. NRL/PP/7440-00-1007.

Gendron, M., Edwards, S., Myrick, S., Lohrenz, M. and Trenchard, M.; A Client/Server Based Application Using A C/Java Interface. Presented at the Southern Conference on Computing, Hattiesburg, MS., October 26-28, 2000. NRL/PP/7440-00-1009.

Gendron, M. and Hammack, J.; Wavelet Multi-Scale Edge Detection Using An Adaline Neural Network To Match Up Edge Indicators. Presented at the 2002 International Conference On Industry, Engineering, and Management Systems, Cocoa Beach, FL., March 11-13, 2002. NRL/OP/7440-02-1005.

Gendron, M. and Hammack, J.; Wavelet Multi-Scale Edge Detection Using An Adaline Neural Network To Match Up Edge Indicators. Presented at the 2002 International Conference

On Industry, Engineering, and Management Systems, Cocoa Beach, FL., March 11-13, 2002. NRL/PP/7440-01-1016.

Givaudan, J., Abdelguerfi, M., **Shaw, K.** and Ladner, R.; The 2-3TR-tree, A Trajectory-Oriented Index Structure For Fully Evolving Valid-Time Spatio-Temporal Datasets. Published at the ACM GIS Conference, New Orleans, LA., September 1, 2002. NRL/PP/7440—02-1015.

Harris, M., Avera, W., Gendron, M. and Seldenright, V.; Acquiring Bathymetry Data With The VSS Sonar On The AQS-20 Mine Hunting System. Presented at the Second Australian-American Joint Conference On The Technologies Of Mine Countermeasures, Sydney, Australia, March 27-29, 2001. NRL/PP/7440-01-1002.

Harris, M., Avera, W., Bibee, L. and Null, J. M.; Environmental Data Collection From The AQS-20. Published in the 5th International Symposium on Technology And The Mine Problem Journal, April 21-25, 2002. NRL/JA/7440—02-1004.

Harris, M. and James, D.; Mapping, Charting and Geodesy Branch Abstracts of Publications, 1998 and 1999. Published June 2000 as NRL/PU/7440—00-419.

Harris, M., Avera, W. and Bibee, L.; Tow Vehicle Depth Verification. Presented at the Oceans 2002 Conference and Exhibition, Biloxi, MS., October 29-31, 2002. NRL/PP/7440—02-1008.

Holland, K. T.; KB01 Red Beach Bathymetry. Presented to the Naval Oceanographic Office WSC, Stennis Space Center, MS., March 26, 2001. NRL/OP/7440-01-1004.

Holland, K. T.; Littoral Environmental Nowcasting System (LENS). Presented at the Oceans 2002 Conference and Exhibition, Biloxi, MS., October 29-31, 2002. NRL/PP/7440—02-1023.

Holland, K. T.; Overview Of Littoral Dynamics Research. Presented at the SACLANTCEN 2002 Conference, La Spezia, Italy, May 16, 2002. NRL/OP/7440—02-1008.

Holland, K. T., Puleo, J., Kooney, T., Holman, R. and Stanley, J.; Video - Based Sensing Of Surf Environmental Processes, Newport, RI., May 2-5, 2000. NRL/PP/7442-00-0003.

Karam, O., Petry, F. and **Shaw, K.;** A Smart Pointer For A Distributed Spatial Database. Presented at the 13th International Conference on Industrial/Engineering Applications of Artificial Intelligence & Expert Systems, June 19-22, 2000. NRL/PP/7441-00-0002.

Ladner, R., Abdelguerfi, M., Wilson, R., McCreedy, F., Breckenridge, J. and Shaw, K.; A Data Structure For 3D Synthetic Environment Reconstruction. Presented at the International Conference On Augmented, Virtual Environments and 3-D Imaging, Mykonos, Greece, May 30 - June 1, 2001. NRL/PP/7440-01-1005.

Ladner, R., Abdelguerfi, M., Klos, L., Richard III, G., Liu, B. and Shaw, K.; A Distributed Virtual Reality Prototype For Real Time GPS Data. Presented at the 2nd International Symposium on Telegeoprocessing, Nice, France, May 10-12, 2000. NRL/PP/7441-00-0006.

Ladner, R., Abdelguerfi, M., Wilson, R., Breckenridge, J., McCreedy, F. and Shaw, K.; A Framework For Databasing 3D Synthetic Environment Data. Presented at the 12th International Conference On Database And Expert Systems Applications, Munich, Germany, September 3-7, 2001. NRL/PP/7440-01-1004.

Ladner, R. and Petry, F.; Assessment Of Spatial Data Mining Tools For Integration Into An Object-Oriented GIS (GIDB). Presented at the DEXA 2002 Conference, Aix-en-Provence, France, September 2-6, 2002. NRL/PP/7440—02-1004.

Ladner, R. and Petry, F.; Knowledge Discovery In Oceanographic Databases: Issues Of Complications In Data Sources. Presented at the Oceans 2002 Conference and Exhibition, Biloxi, MS., October 29-31, 2002. NRL/PP/7440—02-1026.

Ladner, R., Sample, J. and Shaw, K.; Using Wavelet Transforms In 3D Mapping. Presented at the Aero Sense Conference, Orlando, FL., April 1-9, 2002. NRL/PP/7440—02-1005.

Lea, S., Kissling, G., O'Dell, T. and **Lybanon, M.;** Water Depth Determination From Wave Crest Images (Invited). Presented at the 2001 IEEE International Symposium on Intelligent Signal Processing and Communications Systems, Nashville, TN., November 20-23, 2001. NRL/PP/7440-01-1013.

Lohrenz, M., Trenchard, M., Edwards, S. and Collins, C.; A Pilot-Centered Evaluation Of Geospatial Data For Proposed Naval Helicopter Moving-Map Displays. Presented at the International Conference On Human-Computer Interaction In Aeronautics (HCI-Aero 2002), Cambridge, MA., October 23-25, 2002. NRL/PP/7440—02-1011.

Lohrenz, M., Trenchard, M., Myrick, S. and Edwards, S.; An Evaluation Of Vector Geospatial Databases In Cockpit Moving-Map Displays To Improve Pilot Performance. Presented at the Human Performance, Situation Awareness and Automation: User-Centered Design For The New Millennium, October 15-19, 2000. NRL/PP/7440-00-0014.

Lohrenz, M., Trenchard, M. and Edwards, S.; An On-Line Evaluation Of Cockpit Moving-Map Displays To Enhance Situation Awareness In Anti-Submarine Warfare And Mine Countermeasures Operations. Presented at the HCI International 2001 9th International Conference On Human-Computer Interaction, New Orleans, LA., August 5-10, 2001. NRL/PP/7440-01-1008.

Lohrenz, M., Gendron, M., Edwards, S., Mang, R., Myrick, S. and Trenchard, M.; Demonstrating A Moving Map System For Improved Lane Navigation And Situational

Awareness. Presented at the Oceans 2002 Conference, Biloxi, MS., October 29-31, 2002. NRL/PT/7440—02-1003.

Lohrenz, M., Edwards, S., Myrick, S., Gendron, M., and Trenchard, M.; Internet-Based Surveys And On-Line Evaluations Of Digital Moving-Map Displays For Military Aircraft. Presented at the Southern Conference on Computing, Hattiesburg, MS., October 26-28, 2000. NRL/PP/7440-00-1002.

Lohrenz, M. and Trenchard, M.; Moving-Map Support To ASW/MCM Operations. Presented at the TAMMAC Users' Group Conference, February 8, 2001. NRL/OP/7440-01-1001.

Lohrenz, M., Myrick, S. and McMurray, LT.; Proceedings Of The NRLSSC Symposium On Vector Moving Map Display. Presented at the Victor Moving Map Symposium, August 3-4, 1999. NRL/PP/7441-00-0008.

Martinez, A. and **Bourgeois, B.**; Wavimeter. Presented at the Oceans 2002 Conference, Biloxi, MS., October 29-31, 2002. NRL/PP/7440—02-1021.

McCreedy, F., Wilson, R. and Shaw, K.; Design Of A Naval Research Laboratory (NRL) System For Area Of Interest Access To Large Volumes Of Bathymetric Data. Presented at the Oceans 2002 Conference and Exhibition, Biloxi, MS., October 29-31, 2002. NRL/PP/7440—02-1009.

McDowell, P., Iyengar, S., Gendron, M., Bourgeois, B. and Sample, J.; Control/Learning Architectures For Use In Robots Operating In Unstructured Environments. Presented at the Southern Conference on Computing, Hattiesburg, MS., October 26-28, 2000. NRL/PP/7440-00-1008.

McDowell, P., Bourgeois, B., Cheramie, J. and Gravley, J.; Objective Based Dynamic Navigation Planning. Presented at the UUST 2001 International Symposium, Durham, NC., August 27-29, 2001. NRL/PP/7440-01-1011.

McDowell, P., Chen, J. and Bourgeois, B.; UUV Teams, Control From A Biological Perspective. Presented at the Oceans 2002 Conference and Exhibition, Biloxi, MS., October 29-31, 2002. NRL/PP/7440—02-1025.

Morgan, L., Myers, L. and Bourgeois, B.; A Parameterized Model For Point-To-Event Distances Of Regular Point Patterns. Presented at the Eastern North American Region Conference, March 25-28, 2001. NRL/PP/7440-01-1001.

Morgan, L., Martinez, A., Myers, L. and Bourgeois, B.; Distribution Fitting Of A Regular Point Process. Presented at the American Statistical Association 2001 Joint Statistical Meeting, Atlanta, GA., August 5-9, 2001. NRL/PP/7440—01-1006.

Morgan, L., Martinez, A., Myers, L. and Bourgeois, B.; Statistical Characterization Of

Multibeam Bathymetry Data. Presented at the Joint Statistical Meetings 2001 Conference, Atlanta, GA., August 5-9, 2001.

Myrick, S., Gendron, M., Lohrenz, M. and Edwards, S.; The Design And Development Of An Internet-Based Graphical User Interface Using A Commercial Design Tool And Java. Presented at the Southern Conference on Computing, Hattiesburg, MS., October 26-28, 2000. NRL/PP/7440-00-1010.

Myrick, S., Gendron, M., Lohrenz, M. and Watkins, J.; The Moving-Map Composer: A GUI-Based Map Design System For Navy Aviators. Presented at the HCI International 2001 9th International Conference On Human-Computer Interaction, New Orleans, LA., August 5-10, 2001. NRL/PP/7440-01-1007.

Nelson, J., **Avera, W.** and DelBalzo, D.; Status Of The NRL/DREA MAD Tactical Decision Aid Project. Presented at the TTCP Conference, Halifax, Nova Scotia, October 23-27, 2000.

Plant, N.; Evaluation Of Nearshore Profile Predictions. Presented at the International Conference Of Coastal Engineers, Cardiff, Wales, UK., July 8, 2002. NRL/PP/7440—02-1019.

Puleo, J., Holland, K. T. and Sallenger, A.; Field Observations Of Three-Dimensional Swash Zone Flow Patterns And Morphodynamics. Published at the Coastal Engineering Conference, July 2000. NRL/PP/7442-00-0001.

Puleo, J., Holland, K. T. and Slinn, D.; Numerical Modelling Of Swash Zone Hydrodynamics. Presented at the International Conference Of Coastal Engineers, Cardiff, Wales, UK., July 8, 2002. NRL/PP/7440—02-1018.

Sample, J. and Bentrem, F.; Progress Update For The Sedimap Project. Presented to NAVOCEANO, Stennis Space Center, MS., June 14, 2002. NRL/OP/7440—02-1012.

Steed, C., Braud, J. and Koehler, K.; VGRID: A Generic, Dynamic HDF5 Storage Model For Environmental, Grid Data. Presented at the Oceans 2002 Conference and Exhibition, Biloxi, MS., October 29-31, 2002. NRL/PP/7440—02-1003.

Trenchard, M., Lohrenz, M., Myrick, S. and Gendron, M.; A Two-Part Study On The Use Of Bathymetric And Nautical Mapping Information In A Moving Display To Support Mine Counter Measures Operations. Presented at the Human Performance, Situation Awareness and Automation: User-Centered Design For The New Millennium, October 15-19, 2000. NRL/PP/7440-00-0013.

Trenchard, M., Gendron, M., Edwards, S. and Myrick, S.; Evaluation And Comparison Of GOTS Digital Mapping Software To Support High Resolution Digital Mapping For Precise Lane Navigation On Amphibious Assault Vehicles. Presented at the Oceans 2002 Conference and Exhibition, Biloxi, MS., October 29-31, 2002. NRL/PP/7440—02-1014.

Trenchard, M. and Myrick, S.; FAF Moving-Map Composer Phase I Program Review. Presented to the Finland Air Force, Stennis Space Center, MS., May 24, 2002. NRL/OP/7440—02-1009.

Trenchard, M.; TAMMAC Application Of NIMA Geospatial Information. Presented at the PMA 209 Users Conference, San Diego, CA., February 7, 2002. NRL/OP/7440—02-1001.

Trenchard, M. and LCDR Pat Waring; TAMMAC Use Of NIMA Geospatial Products. Presented at the TAMMAC User's Group Conference, San Diego, CA., February 5-9, 2001. NRL/OP/7440-01-1002.

Wilson, R., McCreedy, F., Ladner, R., Chung, M. and Shaw, K.; Designs And Lessons Learned In Object-Oriented Web-Based Mapping. Presented at the Southern Conference on Computing, Hattiesburg, MS., October 26-28, 2000. NRL/PP/7440-00-1012.

Yang, H., Cobb, M. and **Shaw, K.;** A Clips-Based Implementation For Querying Binary Spatial Relationships. Presented at the North American Fuzzy Information Processing Society (NAFIPS), Vancouver, Canada, July 25-28, 2001. NRL/PP/7440-01-1003.

Yang, H., Cobb, M., Ali, D., Rahimi, S., Petry, F. and **Shaw, K.;** Fuzzy Spatial Querying With Inexact Inference. Presented at the North American Fuzzy Information Processing Society (NAFIPS) 2002 Conference, New Orleans, LA., June 2002. NRL/PP/7440—02-1012.

2.7 ABSTRACTS

Chung, M., Wilson, R., Holland, K. T., Breckenridge, J., Shaw, K., Reed, C. and Dale, J.; Characterization Of The Littoral Zone. Presented at the International Geographic Congress Conference, Seoul, Korea, August 14-18, 2000. NRL/AB/7441-00-0004.

Bentrem, F. and Sample, J.; Acoustic Seafloor Characterization In Onslow Bay From EM 121A Hydrophone Data. Presented at the Mississippi Academy of Sciences Annual Meeting in Biloxi, MS., on February 21-22, 2002 and published in the April 2002 Journal. NRL/AB/7440—01-1014.

Bentrem, F., Sample, J. and Avera, W.; Seafloor Characterization From Inversion Of High-Frequency Backscatter. Presented to the First Pan-American/Iberian Meeting On Acoustics, Cancun, Yucatan, Mexico, December 2-6, 2002. NRL/AB/7440-02-1005.

DelBalzo, D. and **Avera, W.;** MAD TDA Rodeo Quick-Look Results. Presented to NAVAIR Sponsor, August 25, 2001.

Elmore, P., Chahine, G. and Oguz, H.; Cavity And Flow Studies Of Reproducible Bubble Entrainment Events With Rain. Presented at the American Geophysical Union 2002 Fall Meeting, San Francisco, CA., November 19, 2002. NRL/AB/7440—02-1004.

Gendron, M., Myrick, S. and Trenchard, M.; The Development Of Software Tools For Scanning Paper Charts Into Geotiff Image Files. Presented at the Mississippi Academy of Sciences Annual Meeting, Biloxi, MS., February 21-22, 2002. NRL/AB/7440—01-1008.

Holland, K. T., Plant, N. and Holman, R.; An Optimal Approach To Nearshore Bathymetric Estimation. Presented at the American Geophysical Union 2002 Fall Meeting, San Francisco, CA., November 19, 2002. NRL/AB/7440—02-1001.

Holland, K. T., Williams, Z., Piotrowski, C. and Dugan, J.; High-Resolution, Video Based Quantification Of Surf Zone Processes. Published at the American Geophysical Union 2001 Fall Meeting, San Francisco, CA., December 2000. NRL/AB/7440-00-0017.

Ioup, J., **Gendron, M.,** Bourgeois, B. and Ioup, G.; Wavelet Denoising Of Sidescan Sonar Images. Published at the 142nd Meeting Of The Acoustical Society Of America, Fort Lauderdale, FL., December 3-7, 2001. NRL/AB/7440-01-1002.

Myrick, S., Gendron, M. and Trenchard, M.; The Design And Development Of Graphical User Interfaces To Consolidate Management Tasks Associated With Navy Aircraft Optical Disks. Presented at the Mississippi Academy of Sciences Annual Meeting, Biloxi, MS., February 21-22, 2002. NRL/AB/7440—01-1007.

Myrick, S., Edwards, S., Lohrenz, M. and Gendron, M.; The Design Of An Internet-Based Survey And Evaluation Of Digital Moving-Maps For Military Aircraft. Published at the Human Performance, Situation Awareness and Automation: User-Centered Design For The New Millennium, Savannah, GA., October 15-19, 2000. NRL/OP/7440-00-0008.

Plant, N. and Holland, K. T.; Are N-Minus-One Dimensional Beaches Predictable? Presented at the American Geophysical Union 2002 Fall Meeting, San Francisco, CA., November 19, 2002. NRL/AB/7440—02-1003.

Plant, N. and Holland, K. T.; Comparison Of Beach Profile Evolution To Predictions From A Nonlinear Model. Presented at the AUG Meeting, San Francisco, CA., December 10-14, 2001. NRL/AB/7440-01-1003.

Puleo, J., Holland, K. T., Farquharson, G., Frasier, S. J. and Raubenheimer, B.; A Comparison Of Remote Sensing And In Situ Measurements Of Nearshore Flows. Presented at the AGU Meeting, San Francisco, CA., December 10-14, 2001. NRL/AB/7440-01-1004.

Puleo, J., Slinn, D., Holland, K. T. and Webb, B.; A Volume Of Fluid Model For Surf And Swash Zones. Presented at the American Geophysical Union 2002 Fall Meeting, San Francisco, CA., November 19, 2002. NRL/AB/7440—02-1002.

Puleo, J., Holland, K. T. and Kooney, T.; Validation Of A Particle Image Velocimetry Technique For Nearshore Flows. Published at the AGU Fall Meeting, San Francisco, CA., December 2000. NRL/AB/7440-00-0016.

Slinn, D., **Holland, K. T.,** Puleo, J. and Hanes, D.; Modeling Small-Scale Nearshore Processes. Presented at the American Geophysical Union 2001 Fall Meeting, San Francisco, CA., December 10-14, 2001. NRL/AB/7440-01-1009.

Steed, C.; A Method For Overcoming Discontinuity Between Neighboring UTM Zone Grids. Presented at the Mississippi Academy of Sciences Annual Meeting, Biloxi, MS., February 21-22, 2002. NRL/AB/7440—01-1006.

Steed, C. and Mesick, H.; Overcoming Discontinuity Between UTM Zones. Presented at the Mississippi Academy of Sciences Annual Meeting, Biloxi, MS., February 20-22, 2002. NRL/OP/7440—02-1003.

2.8 VIDEO

Harris, M., Holland, K. T. and Shaw, K.; Video - Phase I Proof-Of-Concept Demonstration For An Integrated Characterization Of The Littoral Zone, January 14, 2000. NRL/OP/7440-00-0002.

2.9 NRL WEB PAGE

Avera, W. and Kooney, T.; Real Time Geomagnetic Data From The NRL Observatory, August 1, 2000. http://geomag.usgs.gov/wwwplots/BaySt.Louis.html

Harris, M.; Adaptive Sensors And Survey Techniques Team, August 9, 2000. NRL/OP/7440-00-0007. http://postoffice.nrlssc.navy.mil/adaptivesensors/index.html

Harris, M.; NRL MC&G Branch, August 9, 2000. NRL/OP/7440-00-0006. http://postoffice.nrlssc.navy.mil/adaptivesensors/index.html

Holland, K. T.; Web Pages - Nearshore Morphology Team, January 21, 2000. NRL/OP/7442-00-0003.

Lohrenz, M., Gendron, M., Myrick, S., Trenchard, M. and Ioup, J.; Web Site - Moving Map Composer Team Web Site, January 11, 2000. NRL/OP/7440-00-0004.

Puleo, J., Holland, K. T. and Plant, N.; Littoral Dynamics Team, August 23, 2002. NRL/WP/7440—02-1001.

2.10 NRL PATENTS

Beckman, R., Bourgeois, B. and Martinez, A.; Localization Of A Submerged Tow (LOST) Vehicle, July 3, 2001. Navy Case Number 80,239. Patent Number 6256264.

Bourgeois, B., Martinez, A., Alleman, P., Cheramie, J. and Gravley, J.; Autonomous Survey System (AutoSurvey), January 8, 2002. Navy Case Number 79,746. Patent Number 6338023.

Bourgeois, B., Martinez, A. and Harris, M.; Depthimeter, March 13, 2001. Navy Case Number 79,322. Patent Number 6201763.

Gendron, M., Wischow, P., Trenchard, M., Lohrenz, M., Riedlinger, L. and Mehaffey, J. M.; Moving Map Composer, April 17, 2001. Navy Case Number 76, 358. Patent Number 6218965.

Martinez, A. and Bourgeois, B.; Shipboard Wave Measurement System, May 7, 2002. Navy Case Number 80,121. Patent Number 6382022.

3. List of Acronyms

ADV	- acoustic Doppler velocimeters
ADALINE	- ADAptive LInear Neuron
AML	- additional military layers
AAAV	- Advanced Amphibious Assault Vehicle
AEM	- airborne electromagnetic
AROSS	- Airborne Remote Optical Spotlight System
AOD	- aircraft optical disks
AAV	- Amphibious Assault Vehicle
ASW	- anti-submarine warfare
APL-UW	- Applied Physics Laboratory at the University of Washington
ADRG	- Arc Digitized Raster Graphics
AOI	- areas of interest
BLOBs	- binary large objects
CDLZ	- characterization of the dynamic littoral zone
CNO	- Chief of Naval Operations
CLOS	- clear line-of-sight
CCS	- Coastal Systems Station
COTS	- commercial off-the-shelf
CORBA	- Common Object Request Broker Architecture
CDI	- compact disk images
CDROM	- compact disk read-only memory
CSR	- complete spatial randomness
CAC	- compressed aeronautical chart
CAD	- computer aided design
CDC	- CounterDrug Coordinator
CD-GRASS	- counterdrug-geographical regional assessment sensor system
CM	- current meter
DACT	- data automated communications terminal
DART	- database for assessment of requirements and tactics
DREA	- Defence Research Establishment Atlantic
DLA	- Defense Logistics Agency
DoD	- Department of Defense
DBDB-V	- Digital Bathymetric Data Base – Variable Resolution
DIGEST	- Digital Geographic Information Exchange Standard
DMAP	- Digital Mapping, Charting and Geodesy Analysis Program
DMI	- digital mapping initiative
DNC	- digital nautical chart
DTED	- digital terrain elevation data
DWT	- discrete wavelet transform

ENC	- electronic nautical chart
EDM	- Engineering Development Model
EDC	- Environmental Data Collection
ESB	- environment, seabed and beach
FRF	- Field Research Facility
FBE	- Fleet Battle Experiment
GECE	- Generation and Exploitation of the Common Environment
GSF	- generic sensor format
GML	- Geographic Markup Language
GTRI	- Georgia Tech. Research Institute
GI&S	- Geospatial Information and Services
GIDB	- geospatial information database
GIDS	- geospatial information distribution system
GOTS	- government off-the-shelf
GUI	- graphical user interface
HAT	- height-above threshold
HRE	- high resolution environment
HITS	- Hull Integrity Test Sites
HCI	- human-computer interaction
IP	- implementation plan
IT	- information technology
IMMACCS	- Integrated Marine Corps Multi-Agent Command and Control System
ISS-60	- integrated survey system-60
IDL	- interface definition language
KB	- Kernal Blitz
LCAC	- landing craft air cushion
LCU	- landing craft utility
LEA	- law enforcement agents
LMS	- least mean squared
LOST	- localization of a submerged towed
MAD	- magnetic anomaly detectors
MOMS	- Map, Operator, and Maintenance Stations
MC&G	- Mapping, Charting and Geodesy
MCWL	- Marine Corps Warfighting Laboratory
MFF	- Maritime Foundation and Facilities
MGRS	- Military Grid Reference System
MCM	- mine countermeasures
MEDAL	- Mine Warfare Environmental Decision Aids Library

MPS - Mission Planning System
MCEDSS - Mississippi Cannabis Eradication Decision Support System
MM - moving map
MMC - Moving Map Composer

NGB-CD - National Guard Bureau-CounterDrug
NIMA - National Imagery & Mapping Agency
NOAA - National Oceanic and Atmospheric Administration
NASB - Naval Air Station Brunswick
NAVAIR - Naval Air Systems Command
NAVOCEANO- Naval Oceanographic Office
NRL - Naval Research Laboratory
NAVSEA - Naval Sea Systems Command
NAVSSI - Navigation Sensor System Interface
NLSWE - non-linear shallow water equations
NtM - Notice to Mariners
N096 - Oceanographer of the Navy

OO - object-oriented
ODBMS - Object-Oriented Database Management System
OMS - Ocean Magnetotelluric Systems
ORCA - Oceanographic Remotely Controlled Automaton
ONR - Office of Naval Research

PIV - particle image velocimetry
PC - personal computer
PFPS - Portable Flight Planning System
PNT - Position, Navigation and Timing
PUMA - Precision Underwater MApping system
PMS - Program Management System

RPF - raster product format
RMS - root-mean-square

SWMS - Shipboard Wave Measurement System
SA - situational awareness
SPAWARS - Space and Naval Warfare System
STIS - Spatio-Temporal Information Systems
SSC - Stennis Space Center

TAMMAC - Tactical Aircraft Moving Map Capability
TDA - tactical decision aid
TOD4 - Tactical Oceanographic Data Level 4
TRR - Test Readiness Review
TPS - text product standard

3D	- three-dimensional
TTS	- Through-The-Sensor
TRIFOCAL	- Tri-Parametric Focusing and Locating
2D	- two-dimensional
USMC	- United States Marine Corps
UPS	- Universal Polar Stereographic
UTM	- Universal Transverse Mercator
UAV	- unmanned aerial vehicles
UUV	- unmanned underwater vessel
VDU	- vector data update
VPF	- vector product format
VSS	- volume search sonar
WMED	- Wavelet Multiscale Edge Detector
WMT	- Web Mapping Toolkit
WMO	- World Meteorological Organization

4. **ABSTRACTS** (Alphabetical by First MC&G Author)

(Avera)

ACOUSTIC VERIFICATION OF NONACOUSTIC DETECTION USING FLUCTUATION-BASED PROCESSING (U)

Wagstaff, R. Kinney, W. Avera, W.
Bibee, L. Mobbs, J. Showalter, J.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

The abstract is classified.

Sponsored by the Naval Research Laboratory.

Published in the *Journal Of Underwater Acoustics,* July 2000.
Naval Research Laboratory Contribution Number NRL/JA/7442--98-0118.
Journal Article (Refereed)

(Avera)

ACQUIRING BATHYMETRY DATA WITH THE AQS-20 MINE HUNTING SYSTEM

Avera, W. Harris, M.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004
Horton, J.
Naval Surface Warfare Center
Coastal System Station, FL

Abstract

A goal of future naval development is to utilize fleet systems to acquire ocean environment measurements for tactical use 'on the spot'. A preliminary evaluation of data indicates that a future operational mine hunting system can provide needed bathymetry data in regions where adequate data does not exist. Bathymetric data is obtained from existing sensors on a prototype system to illustrate the capability. The prototype mine hunting system used in this analysis, the AQS-20, is under development at the Naval Surface Warfare Center Coastal System Station. This system will be a helicopter-towed mine hunting system with the capability to obtain coarse bathymetry data. The data are sufficient to meet the accuracy requirements for mine warfare operations.

Sponsored by the Oceanographer of the Navy via SPAWAR PMW 185, Program Element Number 0603704N, Capt. C. Hopkins, USN, Program Manager.

Presented at the 4th International Symposium on Technology and the Mine Problem, March 12-16, 2000.
Published on CD, Pillar #2, Paper #2, Pages 1-6.
Naval Research Laboratory Contribution Number NRL/PP/7442--00-0004.
Conference Proceedings

(Avera)

A NEW ELECTRICALLY ISOLATED TOWED ELECTRIC FIELD SOURCE FOR OCEANOGRAPHIC SURVEYS

Avera, W. Kooney, T. Bibee, L. Mang, R.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004
Mozley, E.
SPAWAR, PMW 185
San Diego, CA 92110-3127
Reynaud, J.
Mississippi State University
Stennis Space Center, MS 39529-5004

Abstract

An undersea electromagnetic system has been developed by the Naval Research Laboratory to be used in field surveys to determine sub-sea electrical properties and relate them to the sediment type and stratigraphic structure. The sediment's electrical properties are closely related to its pore structure and interstitial fluid. This paper will focus on the core components of the undersea electromagnetic system used to conduct these surveys.

The equipment developed was tested off the coast of northern California near Humbolt Bay. The area has been studied by researchers brought together by the Office of Naval Research (ONR) to gain a better understanding of the relationship between depositional processes and the strata that reside in the geologic record. The ONR program, STRATAFORM [1], has been focused on understanding the spatial and temporal relationship of geologic processes to the strata being created. A suite of oceanographic measurements and bottom core samples have been taken over the past two years to characterize the shelf environment and the local sedimentation characteristics at the site.

This work focused on measuring the electrical properties of the near surface sediments and relating this to the depositional processes. The electromagnetic measurements were made using separate source and receiver equipment with continuous range separations. The recording instruments consisted of three autonomous ocean magnetotelluric systems (OMS) deployed on the seafloor at 62m water depth near a site of extensive oceanographic and sediment transport studies by other investigators. A submerged electric bipole source was towed with a ship over the OMS recording instruments to "sound" out the bottom electrical properties.

In addition to basic research conducted in this project, electric measurements of shallow coastal regions have a variety of applications. Exploration for mineral deposits is of significant interest since the vast coastal areas of most continents remain undeveloped. The potential to extend geologic trends for mining offshore is only just beginning. Also the application of electrical techniques to ocean bottom sediment properties can enhance environmental surveys for offshore construction and cable/pipeline burial.

Sponsored by the Office of Naval Research.

Published in the *Sea Technology Publications,* February 2000.
Naval Research Laboratory Contribution Number NRL/JA/7442–99-0014.
Journal Article

(Avera)

BATHYMETRY AND BOTTOM ELECTRICAL PROPERTIES FROM AN AIRBORNE ELECTROMAGNETIC SURVEY AT KINGS BAY GEORGIA

Avera, W.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004
Mozley, E.
SPAWAR
San Diego, CA 92110

Abstract

The Naval Research Laboratory deployed an advanced airborne electromagnetic (AEM) hydrographic system over the Kings Bay entrance channel to chart water depths and map variations in sea floor sediments. The survey consisted of three helicopter flights and resulted in the acquisition of high quality data that had the same areal coverage as two high density acoustic surveys. In addition, water temperature and conductivity measurements were acquired over the tidal cycle and along the surveyed channel. These data sets provided the ideal information to evaluate the capabilities of the AEM technology.

The interpretation of the AEM survey indicated that the inferred water conductivities agreed with in-situ measurements to an accuracy of 0.1 Siemens/meter. The average water depths provided by the AEM system along the 5300 foot survey lines deviated from the acoustic data by less than two feet. Seafloor conductivities were spatially coherent and provided realistic formation factors ranging from 3.2-9.5 that should correspond to variations in bottom material ranging from a clean consolidated sand to a poorly consolidated clay or silt.

Sponsored by the Office of Naval Research.

Presented at the MARELEC Marine & Electromagnetics Conference & Exhibition 2001, July 11-13, 2001, Stockholme, Sweden.
Naval Research Laboratory Contribution Number NRL/PP/7440--00-1014.
Conference Proceedings

(Avera)

DEVELOPMENT OF AN ELECTRICAL CONDUCTIVITY MODEL WITH APPLICATION TO A SUBMARINE EXTREMELY LOW FREQUENCY ELECTRIC SIGNATURE (U)

Avera, W. Kinney, W.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004
Mozley, E.
SPAWAR
San Diego, CA 92110

Abstract

The abstract is classified.

Sponsored by the Naval Research Laboratory.

Published in the *Journal Of Underwater Acoustics* 49, No. 3, Pages 531-543, July 2000.
Journal Article (Refereed)

(Avera)

ENVIRONMENTAL REQUIREMENTS FOR THROUGH THE SENSORS SUPPORT OF MINE WARFARE

Avera, W. Harris, M.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

The marine environment has a significant influence on the Navy's ability to find, clear, and plant mines. This report summarizes the TTS concept for MIW and identifies environmental parameters that can be obtained with fleet sensors. The primary user of the data is the MEDAL decision aid library. Several sensors have been evaluated under NRL's 6.2 T'TS program and determined suitable to provide data for the TTS concept. These include the UQN-4, SQQ-32, AQS-14, BQN-17, and the AQS-20. Data can be passed from the sensors to the post-mission analysis system, to a bottom mapping system, and then sent out using the standard messaging systems to be imported into the MEDAL database. The bottom mapping system is the main link in the data flow that does not have an existing Fleet system already in place. Research issues and the requirements accuracy for needed environmental parameters are summarized.

Sponsored by the Oceanographer of the Navy via SPAWAR PMW 185, Program Element Number 0603207N, Capt. C. Hopkins, USN, Program Manager.

Published as a Naval Research Laboratory Memorandum Report, March 13, 2000.
Naval Research Laboratory Contribution Number NRL/MR/7440--00-8236.
NRL Memorandum Report
1-9 Pages

(Avera)

MAD TDA RODEO QUICK-LOOK RESULTS

DelBalzo, D. Avera, W.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

The Naval Research Lab (NRL) is developing a tactical decision aid (TDA) for use with Magnetic Anomaly Detectors (MAD) as an ASW search sensor in shallow water areas. The environmental aspects of this non-acoustic ASW work are sponsored by SPAWAR (PMW-185) and the tactical portion is sponsored by NAVAIR (PMA-264). The work is coordinated through the Beartrap Special Projects Office at Naval Air Station Brunswick (NASB), Maine. The first demonstration of initial capability was conducted at NASB during June 28-29, 2000. This quick-look report is a summary of the results of the first MAD TDA demonstration (nicknamed MAD TDA Rodeo). A complete report will follow discussing the details of the rodeo and background on the project.

Sponsored by Quicklook Report.

Presented to NAVAIR Sponsor, August 25, 2001.
Abstract

(Avera)

MAGNETIC AND EM PROJECTS OVERVIEW

Avera, W.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

EM Overview

- MAD Tactical Decision Aid
- Airborne EM System and Bathymetry
- Eureka California Experiment
  - Underwater Magnetometer System
  - Underwater Towed EM Source

Sponsored by the Office of Naval Research.

Presented to the Japanese Defense Agency Delegates at the Office Of Naval Research, April 2, 2002, Washington, DC.
Naval Research Laboratory Contribution Number NRL/OP/7440–02-1006.
Oral Presentation
35 Pages

(Avera)

MAGNETIC ANOMALY DETECTION IN THE HIGH ARCTIC BARENTS SEA (U)

Nelson, J.
Defence Research Establishment
Canada
Avera, W.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

(U) A low-noise magnetometer and data acquisition system from the Defence Research Establishment Atlantic (DREA) was installed on a Naval Research Laboratory (NRL) P-3 aircraft and used to conduct an aeromagnetic survey of the high-Arctic and northern Barents Sea in the Summer of 1999. Combining these data with information on submarines in the Russian Northern Submarine Fleet has yielded estimates of the performance for a variety of magnetic anomaly detection (MAD) systems in the survey area. Estimates of MAD performance in other parts of the Barents Sea area are based on available geophysical data.

Sponsored by the Naval Research Laboratory.

Published as a Naval Research Laboratory Formal Report, March 2001.
Naval Research Laboratory Contribution Number NRL/FR/7440--00-9967.
NRL Formal Report

(Avera)

MULTIBEAM BATHYMETRY FROM A MINE-HUNTING MILITARY SONAR

Avera, W. Harris, M. Bibee, L. Sample, J.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004
Lingsch, S.
Naval Oceanographic Office
Stennis Space Center, MS 39529-5004

Abstract

Multibeam bathymetry is obtained from the AQS-20 mine-hunting sonar system. The AQS-20 Volume Search Sonar uses a swath of beams covering more than 180 degrees around the sensor directed downward and perpendicular to the direction of motion. This coverage creates a coarse sampling multibeam sonar that can measure the bottom depth. Raw beamformed data are available from a dedicated experiment to demonstrate the feasibility for using this system to update existing databases with multibeam bathymetry during mine hunting operations. Data processing uses a weighted-mean-time technique to determine the bottom reflection return from the downward directed beams within ±45 degrees of the nadir beam (producing ~ 90 degree swath). Data are compared with a recent multibeam survey covering the same location to determine the accuracy and optimize the data processing. The recent multibeam survey was obtained as a 'ground truth' using a conventional EM-1002 multibeam system. Comparison of the AQS-20 data with the ground truth demonstrated good agreement for bathymetry and is within the requirements for mine warfare operations. Limitations on the bathymetry accuracy are related to the pressure sensor measuring tow-body depth.

Sponsored by SPAWAR PMW 155.

Presented in the 5th International Symposium on Technology And The Mine Problem Conference, April 21-25, 2002.
Naval Research Laboratory Contribution Number NRL/PP/7440--02-1020.
Conference Proceedings
16 Pages

(Avera)

MULTIBEAM BATHYMETRY FROM A MINE-HUNTING MILITARY SONAR

Avera, W. Harris, M. Bibee, L. Sample, J.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004
Lingsch, S.
Naval Oceanographic Office
Stennis Space Center, MS 39529-5004

Abstract

Multibeam bathymetry is obtained from the AQS-20 mine-hunting sonar system. The AQS-20 Volume Search Sonar uses a swath of beams covering more than 180 degrees around the sensor directed downward and perpendicular to the direction of motion. This coverage creates a coarse sampling multibeam sonar that can measure the bottom depth. Raw beamformed data are available from a dedicated experiment to demonstrate the feasibility for using this system to update existing databases with multibeam bathymetry during mine hunting operations. Data processing uses a weighted-mean-time technique to determine the bottom reflection return from the downward directed beams within ±45 degrees of the nadir beam (producing ~ 90 degree swath). Data are compared with a recent multibeam survey covering the same location to determine the accuracy and optimize the data processing. The recent multibeam survey was obtained as a 'ground truth' using a conventional EM-1002 multibeam system. Comparison of the AQS-20 data with the ground truth demonstrated good agreement for bathymetry and is within the requirements for mine warfare operations. Limitations on the bathymetry accuracy are related to the pressure sensor measuring tow-body depth.

Sponsored by SPAWAR PMW 155.

Published in the *Journal of the Society for Counter-Ordnance Technology*, May 27, 2002.
Naval Research Laboratory Contribution Number NRL/JA/7440--02-1010.
Journal Article
16 Pages

(Avera)

SENSITIVITY OF PROBABILITY OF DETECTION TO VARIATIONS IN ENVIRONMENTAL PARAMETERS FOR MULTISENSOR SYSTEMS (U)

Kinney, W. Avera, W. Showalter, J.
Sanders, W. Killingsworth, K.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

The abstract is classified.

Sponsored by the Naval Research Laboratory.

Published in the *Journal Of Underwater Acoustics,* July 2000.
Journal Article (Refereed)

(Avera)

STATUS OF THE NRL/DREA MAD TACTICAL DECISION AID PROJECT

Nelson, J.
Defence Research Establishment
Canada
Avera, W. DelBalzo, D.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

The Naval Research Laboratory (NRL Stennis) is working with Defence Research Establishment Atlantic (DREA) on a multi-year project to develop a network-centric magnetic anomaly detection (MAD) tactical decision aid for shallow-water anti- submarine warfare. The project will demonstrate that existing databases of high quality aeromagnetic data, and new aeromagnetic survey data collected with P3 aircraft, can be used to determine the geological magnetic noise in a given area. These measurements, when combined with estimates of other environmental magnetic noise, can be used to predict the performance of MAD systems against a variety of submarine targets. A genetic algorithm developed by NRL for the optimization of acoustic search patterns is being modified to provide the optimum aircraft flight pattern to detect submarines within a given area and to estimate performance in terms of cumulative probability of detection. The aim of this project is to demonstrate that new environmental survey data can be processed and added to the database and that tactical information can be extracted from the database over a secure network in a tactically useful way. This paper describes the status of the project and recent results from an initial test of the network centric capability.

Sponsored by the Oceanographer of the Navy via the SPAWAR Command.

Presented at the TTCP Conference, October 23-27, 2000, Halifax, Nova Scotia.
Conference Proceedings

(Avera)

THROUGH-THE-SENSORS CONCEPT TO REFRESH THE ENVIRONMENTAL PICTURE

Avera, W. Harris, M. Bibee, L.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

The Naval Research Laboratory (NRL) under the technical direction of SPAWAR PMW-155 and the sponsorship of the Oceanographer of the Navy, N096, have focused research objectives to use military sensors to obtain environmental data. This concept is referred to as Through-The-Sensors (TTS) technology to refresh the environmental picture with fleet deployed sensors. NRL has demonstrated the ability to obtain both multibeam bathymetry and to classify surficial seafloor sediments from the AQS-20 Mine Hunting Sonar. This system will be towed from both the MH-60 helicopter and the AN/WLD-1 Remote Mine Hunting System. In addition, classification of surficial seafloor sediments has also been demonstrated with the UQN-4 surface-ship fathometer and the BQN-17 submarine fathometer. Current work is focused on transitioning these demonstrated capabilities into operational systems.

Sponsored by the Oceanographer of the Navy.

Presented at the NDIA Conference, March 18-22, 2002, San Diego, CA.
Naval Research Laboratory Contribution Number NRL/OP/7440--02-1010.
Oral Presentation
1 Page

(Avera)

UTILIZATION OF MAGNETIC MODELS TO IMPROVE MAGNETIC MICRO-NAVIGATION

Avera, W. Bourgeois, B.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

The Navy and DoD utilize magnetic field measurements in a large number of systems. This report attempts to provide the reader with a fundamental knowledge of the complex sources for the measured magnetic field at the surface of the earth and a perspective on how the measured field is used. The current military requirements for magnetic field information are identified in the report. Since the ability to obtain high resolution geomagnetic variation is an important requirement, the emphasis of this report is on determining a high resolution local magnetic model for navigation applications. Heading accuracy is a critical factor for underwater navigation systems like autonomous underwater vehicles and towed arrays. A technique to develop a model for high resolution navigation is outlined. Research is needed to test these type concepts and determine the accuracy of micro- navigation models.

Sponsored by the Oceanographer of the Navy via SPAWAR PMW 185 Program Element Number 0603207N, Capt. C. Hopkins, USN, Program Manager.

Published as a Naval Research Laboratory Memorandum Report, March 13, 2000.
Naval Research Laboratory Contribution Number NRL/MR/7440--00-8237.
NRL Memorandum Report
1-8 Pages

(Avera)

VP-08 ENVIRONMENTAL MAD SURVEY OF THE BAY OF FUNDY

Avera, W.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004
Nelson, J.
Defense Research Establishment Atlantic
Uplands Ottawa, Ontario, Canada
Chase, H.
COMPATRECONWING FIVE
NAS Brunswick, ME

Abstract

The Naval Research Laboratory (Stennis), in co-operation with the Defence Research Establishment Atlantic (DREA), is developing a Magnetic Anomaly Detection Tactical Decision Aid (TDA) to optimize detection performance in specific operational areas. Two aeromagnetic surveys conducted over the Bay of Fundy — by DREA in 1995 and VP-08 in 2001 — demonstrate that the geologic magnetic noise measurements (that form the basis for the TDA) are very repeatable. In addition, data collected at several altitudes prove that the altitude model algorithm is valid. The survey lines of the VP-08 data are flown in two perpendicular orientations to test the importance of survey orientation on data for the TDA. The two data sets (orientations) agree to within a factor of 2, 90% of the time, and severe disagreements occurs only at the edges of very large magnetic anomalies. This suggests that survey orientation of available data should not be a limiting factor for use in the TDA database. However, a survey-planning tool could improve the reliability of the database. This work demonstrates that the data acquisition, signal processing, and database development used in the TDA is valid, and future work will focus on verifying the TDA predictions.

Sponsored by the Oceanographer of the Navy via SPAWAR PMW 155.

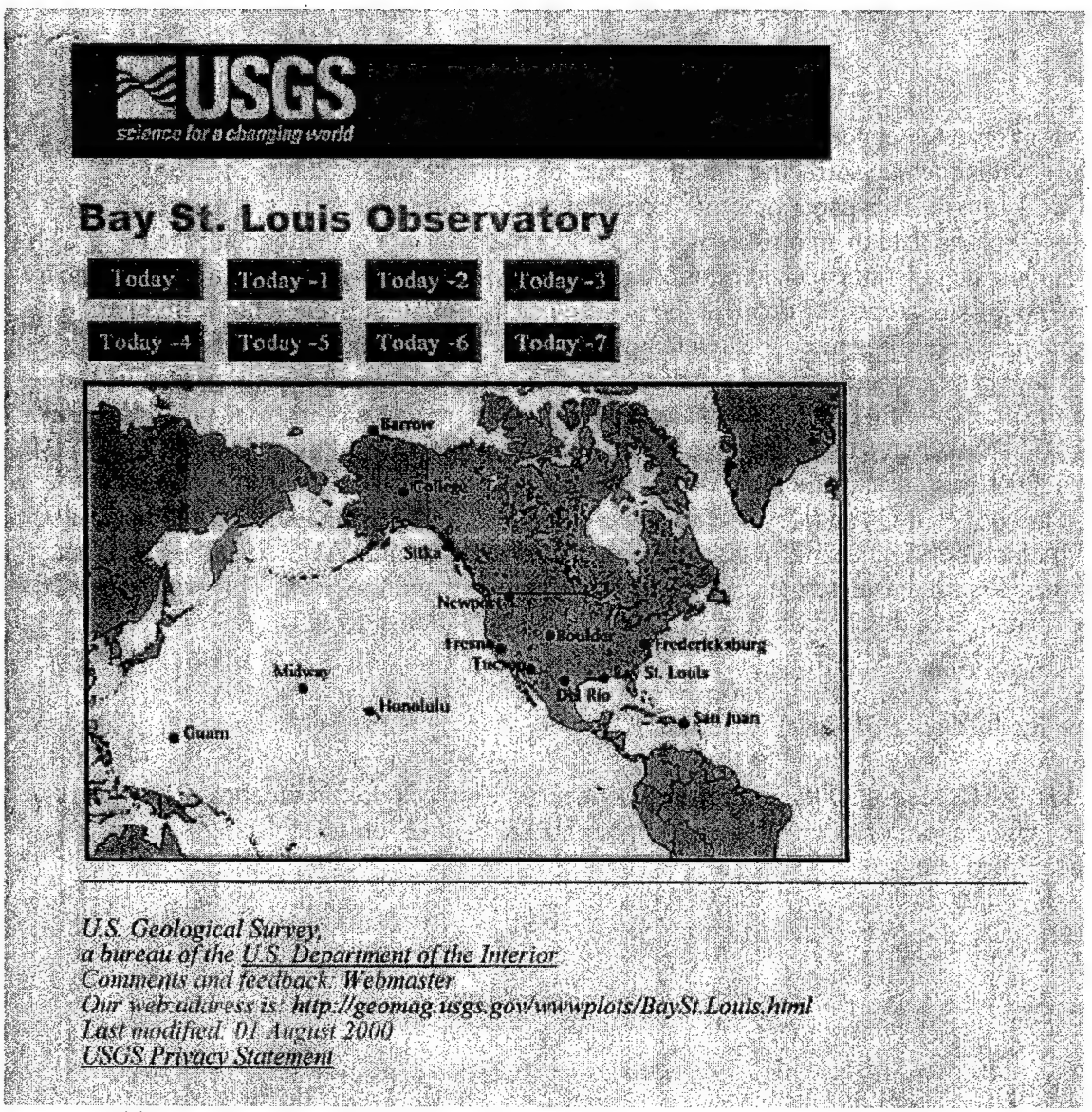
Published in the *Journal of Underwater Acoustics,* August 2002.
Naval Research Laboratory Contribution Number NRL/JA/7440--02-1005.
Journal Article (Refereed)
44 Pages

(Avera)

WEB PAGE - REAL TIME GEOMAGNETIC DATA FROM THE NRL OBSERVATORY

Avera, W. Kooney, T.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract



Sponsored by the U.S. Geological Survey.
Published as a U.S. Geological Survey Web Page, August 1, 2000.
http://geomag.usgs.gov/wwwplots/BaySt.Louis.html
USGS Web Page

(Beckman)

AUV POSITIONING USING BATHYMETRY MATCHING

Beckman, R. Bourgeois, B.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004
Martinez, A.
Tulane University
New Orleans, LA

Abstract

A current research concern in AUV positioning is the constraint of INS error growth; approaches to this include surfacing for GPS fixes, terrain matching methods and acoustic transponder Systems. This paper presents a positioning technique for AUV's that exploits existing bathymetric data in an operation area. Unlike many terrain matching approaches, which do positioning using distinct ocean bottom features, this method generates a position estimate by comparing the in-situ measured depth at the position of the AUV with available bathymetry data in the immediate area. This builds on contemporary AUV INSIVL navigation systems by incorporating a maximum likelihood estimate of position Particular emphasis is placed on the design of the maximum likelihood estimator module which produces point-wise position estimates and typically contains a large error component with many outliers. The AUV's INSJVL system dampens this error while the position estimates act to constrain the drift in the INS position. Further position accuracy and faster convergence to the correct position can be achieved by incorporating a single slant range measurement from the AUV to a fixed location. The slant range is used as external constraint on both the INS and the MLE. This paper describes the implementation of this approach and the results of simulation studies.

Sponsored by the Office of Naval Research.

Presented at IEEE Oceans 2000 Conference, September 11-14, 2000, Providence, RI.
Naval Research Laboratory Contribution Number NRL/PP/7442--00-0011.
Conference Proceedings
On CD

(Beckman)

LOCALIZATION OF A SUBMERGED TOWED (LOST) VEHICLE

Beckman, R. Martinez, A.
Tulane University
New Orleans, LA
Bourgeois, B.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

The Naval Research Laboratory has developed new methods for determining and tracking the position of a towed body. The LOST system determines the position of a towed body using existing or simultaneously collected high-resolution bathymetry data for the operation area.

Sponsored by the Oceanographer of the Navy.

Patented, July 3, 2001
Patent Number 6256264
Navy Case Number 80,239
NRL Patent

(Beckman)

LOST2: A TERRAIN BASED UNDERWATER POSITIONING SYSTEM RESULTS FROM SEA TRIALS

Beckman, R. Martinez, A.
Tulane University
New Orleans, LA
Bourgeois, B.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

This paper develops and demonstrates a new accurate underwater positioning system, LOST2. LOST2 nonlinearly combines pails of dead-reckoning, acoustic-based, and terrain-based positioning into a single integrated system. The LOST2 system is composed of two major subsystems, a system observer and a constrained extended Kalman filter. Inputs to the system are as follows: 1) high resolution bathymetry, 2) measured ocean depth at the position of the vessel, 3) measured or estimated vessel velocity, 4) slant range to and position of a known point, and 5) an initial prediction of the vessel's location. The system is capable of providing position estimates with the same degree of accuracy as present methods, with significantly less hardware. In this paper, the system development is briefly discussed, and results from tow body and UUV sea trials are presented. The results of the field trials demonstrate the viability of the system as a new method to position underwater vessels.

Sponsored by the Office of Naval Research.

Presented at the UUST 2001 International Symposium on Unmanned Untethered Submersible Technology, August 27-29, 2001, Durham, NC.
Naval Research Laboratory Contribution Number NRL/PP/7440—01-1010.
Conference Proceedings
7 Pages

(Beckman)

LOST2: RESULTS FROM GOATS 2000

Beckman, R. Bourgeois, B.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004
Martinez, A.
Tulane University
New Orleans, LA

Abstract

This paper develops and demonstrates a new accurate underwater positioning system, LOST2. LOST2 nonlinearly combines parts of dead-reckoning, acoustic-based, and terrain-based positioning into a single integrated system. The LOST2 system is composed of two major subsystems, a system observer and a constrained extended Kalman filter. Inputs to the system are as follows: 1) high resolution bathymetry, 2) measured ocean depth at the position of the vessel, 3) measured or estimated vessel velocity, 4) slant range to and position of a known point, and 5) an initial prediction of the vessel's location. The system is capable of providing position estimates with the same degree of accuracy as present methods, with significantly less hardware. In this paper, the system development is briefly discussed, and results from tow body and UUV sea trials are presented. The results of the field trials demonstrate the viability of the system as a new method to position underwater vessels.

Keywords: Terrain matching navigation, underwater positioning, underwater navigation, UUV

Sponsored by the Office of Naval Research.

Presented at GOATS 2000 JRP Conference, August 21-23, 2001, La Spezia, Italy at SACLANTCEN.
Naval Research Laboratory Contribution Number NRL/PP/7440—01-1009.
Conference Proceedings
17 Pages

(Bentrem)

ACOUSTIC SEAFLOOR CHARACTERIZATION IN ONSLOW BAY FROM EM 121A HYDROPHONE DATA

Bentrem, F. Sample, J.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

Acoustic inversion of Simrad EM 121A multibeam sonar data is presented for seafloor sediment classification in Onslow Bay. The sonar hydrophone data is beamformed and calibrated and transformed into backscattering strength vs. grazing angle (Sb vs. theta). The Mourad-Jackson backscatter model is used to invert the data via simulated annealing to obtain mean sediment grain size. The inversion results agree with the ground truth sediment types (sand) along the entire shiptrack and closely agrees in the grade of sand (very fine, fine, medium, etc.) for areas with significant sediment layers (>13 cm deep).

Sponsored by SPAWAR.

Presented at the Mississippi Academy of Sciences Annual Meeting, February 21-22, 2002 and published in the April 2002 Journal, Biloxi, MS.
Naval Research Laboratory Contribution Number NRL/AB/7440—01-1014.
Abstract
1 Page

(Bentrem)

HIGH-FREQUENCY ACOUSTIC SEDIMENT CLASSIFICATION IN SHALLOW WATER

Bentrem, F. Sample, J. Kalcic, M.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004
Duncan, M.
Planning Systems, Inc.
Slidell, LA

Abstract

A geoacoustic inversion technique for high-frequency sonar data is presented as a means to classify the seafloor sediment in shallow water. The inversion makes use of backscattered data at a variety of grazing angles which can be obtained with multibeam sonar systems.

Sediment type is important to many operations, yet large areas of the ocean remain unmapped. The need for sediment type and the large amounts of multibeam data being collected with NAVOCEANO's EM 121A systems, have fostered the development of algorithms to process the EM 121A acoustic backscatter into maps of sediment type.

The APL-UW (Applied Physics Laboratory at the University of Washington) backscattering model is used with simulated annealing to invert for six geoacoustic parameters. For the inversion, three of the parameters are constrained according to empirical correlations with mean grain size which is introduced as an unconstained parameter. So the four unconstrained (free) parameters are mean grain size, sediment volume interaction, and two seafloor roughness parameters. The sediments are classified according to mean grain size. Acoustic sediment classification is performed in the Onslow Bay region off the coast of North Carolina using data from the 12kHz Simrad EM 121A multibeam sonar system. Raw hydrophone data is formed into 122 beams with a 120-degree swath on the ocean floor, and backscattering strengths are calculated for each beam and for each ping. Extensive ground truth is available and consists of 68 grab samples in the immediate vicinity of the sonar survey which have been analyzed for mean grain size. Mean grain size from the inversion compares well with the ground truth and may be a useful tool for high-frequency acoustic sediment classification in shallow water.

Sponsored by SPAWAR.

Presented at the Oceans 2002 Conference, October 29-31, 2002, Biloxi, MS.
Naval Research Laboratory Contribution Number NRL/PP/7440—02-1013.
Conference Proceedings
Pages 1001-1005

(Bentrem)

SEAFLOOR CHARACTERIZATION FROM INVERSION OF HIGH-FREQUENCY BACKSCATTER

Bentrem, F. Sample, J. Avera, W.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

Geoacoustic inversion of high-frequency backscatter data is presented for characterization of the seafloor. The APL-UW (Applied Physics Laboratory at the University of Washington) backscattering model is used to model the grazing-angle dependence of the backcattering strength for a number of seafloor parameters. Backscattering strength vs. grazing angle data sets (with frequencies 12-35kHz) are provided for three sites along with sediment ground truth. Roughness measurements are also available for two of the sites. Inversion of these data sets is performed via simulated annealing with some of the parameters constrained by empirical relationships with mean grain size. From the inversion, estimates are obtained for mean grain size, roughness, and volume interation. Inversion of data from a smooth, silty site in Arafura Sea yields estimates in good agreement with ground truth. Results also compare well with ground truth in a rough, sandy site (Quinault) and in Onslow Bay (sand).

Sponsored by SPAWAR.

Presented at the First Pan-American/Iberian Meeting On Acoustics, December 2-6, 2002, Cancun, Yucatan, Mexico.
Naval Research Laboratory Contribution Number NRL/AB/7440—02-1005.
Abstract
1 Page

(Bourgeois)

AUTONOMOUS SURVEY SYSTEM (AUTOSURVEY)

Bourgeois, B.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004
Martinez, A.
Tulane University
New Orleans, LA 70118
Alleman, P. Cheramie, J. Bravley, J.
C&C Technologies, Inc.
Lafayette, LA 70508

Abstract

The NRL AutoSurvey system uses an environmentally adaptive survey approach for swath surveying that minimizes survey time while ensuring data quality. The NRL AutoSurvey system is applicable to any swath type surveying system: Multibeam bathymetry, sidescan sonar, aerial SAR (synthetic aperture radar), laser bathymetry. Swath type sensors are used extensively for both oceanic and terrestrial surveying missions in support of chart/map making, oil and gas exploration, construction, and land use assessment.

Sponsored by the Oceanographer of the Navy.

Patented, January 8, 2002
Patent Number 6338023
Navy Case Number 79,746
NRL Patent

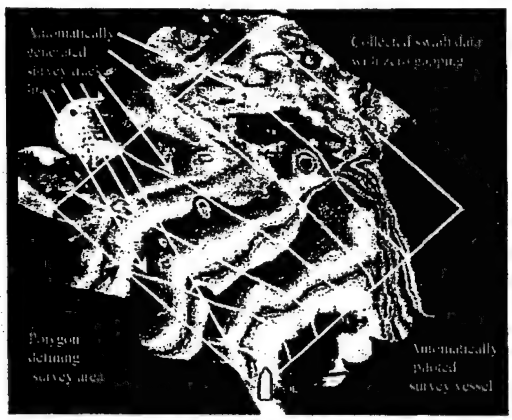
(Bourgeois)

AUTOSURVEY SOFTWARE SYSTEM

Bourgeois, B.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

AUTOSURVEY SOFTWARE SYSTEM



The Naval Research Laboratory's AutoSurvey software system uses an environmentally adaptive approach for swath surveying that minimizes survey time while simultaneously ensuring data quality. AutoSurvey is applicable to any swath-type surveying system: e.g. multibeam bathymetry, sidescan sonar, aerial synthetic aperture radar (SAR), or laser bathymetry.

Advantages include:

- Survey time reduced by 15% or more while ensuring 100% coverage.
- Environmentally adaptive - modifies system deployment based on *in-situ* performance
- Fully automated process reduces risk of human error
- Real-time quantified assessment of data quality and area coverage

Applications include:

- Oceanic and terrestrial surveys for chart/map making
- Oil and gas exploration
- Construction
- Land-use assessment

Points of Contact
Naval Research Laboratory
4555 Overlook Avenue, SW, Washington, DC 20375-5320

Dr. Catherine Cotell • Head, Technology Transfer Office • (202) 767-7230
Dr. B. Bourgeois • Marine Geosciences Division • (228) 688-5321 • bsb@nrlssc.navy.mil

Sponsored by the Naval Research Laboratory.

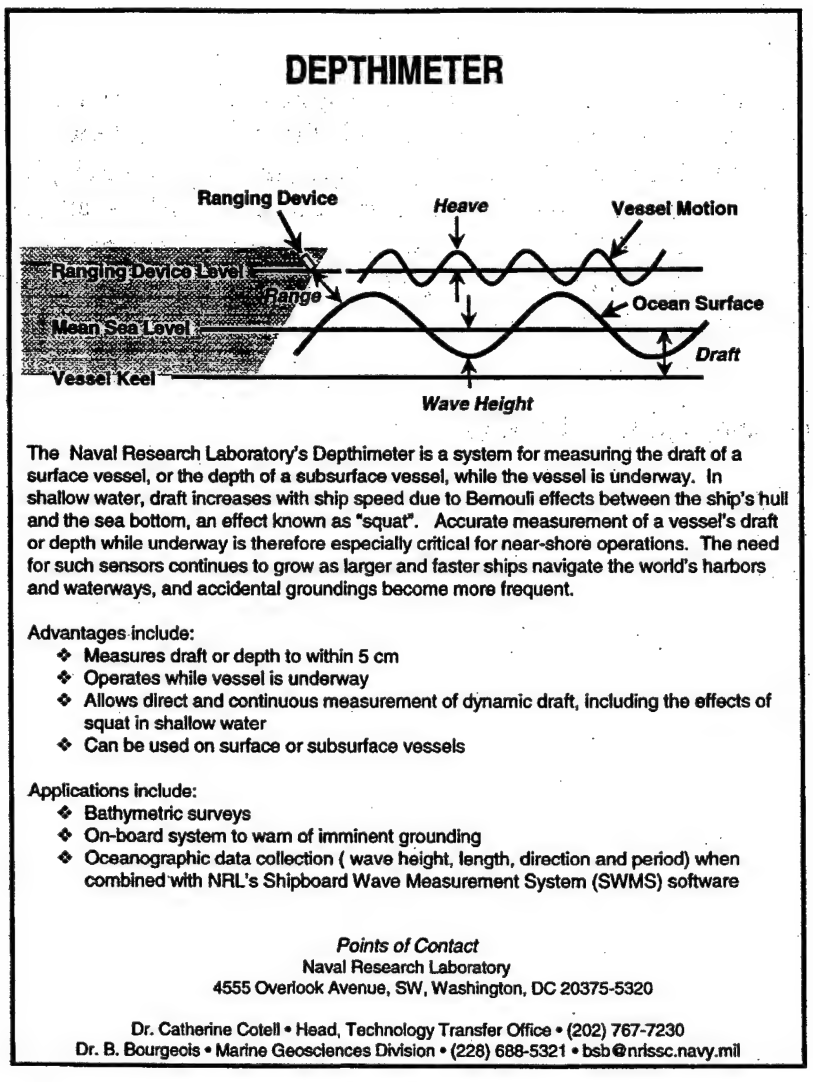
Presented at Technology Transfer Exhibits, 1004/002G.
Conference Proceedings

(Bourgeois)

DEPTHIMETER

Bourgeois, B.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract



Sponsored by the Naval Research Laboratory.

Presented at Technology Transfer Exhibits, 1004/011G.
Conference Proceedings

(Bourgeois)

DEPTHIMETER

Bourgeois, B. Harris, M.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004
Martinez, A.
Tulane University
New Orleans, LA 70118

Abstract

The Naval Research Laboratory's Depthimeter is a system for measuring the draft of a surface vessel, or the depth of a subsurface vessel, while the vessel is underway. In shallow water, draft increases with ship speed due to Bermouli effects between the ship's hull and the sea bottom, an effect known as "squat". Accurate measurement of a vessel's draft or depth while underway is therefore especially critical for near-shore operations. The need for such sensors continues to grow as larger and faster ships navigate the world's harbors and waterways, and accidental groundings become more frequent.

Sponsored by the Oceanographer of the Navy.

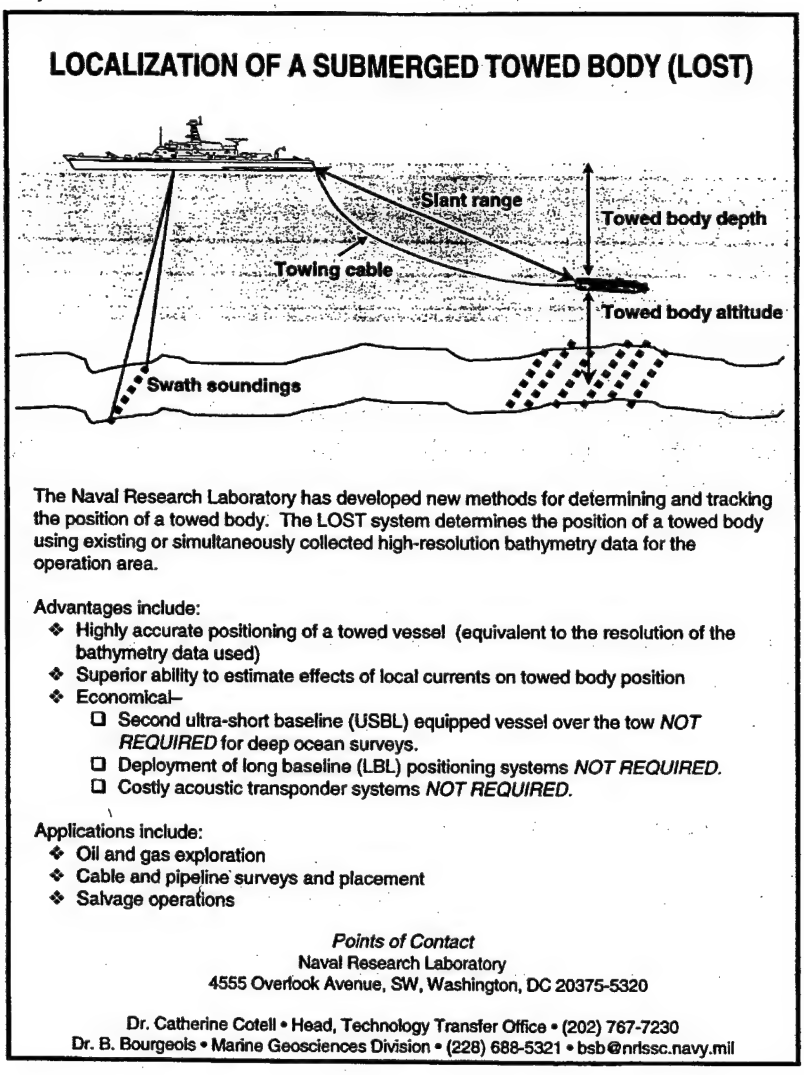
Patented, March 13, 2001
Patent Number 6201763
Navy Case Number 79,322
NRL Patent

(Bourgeois)

LOCALIZATION OF A SUBMERGED TOWED BODY (LOST)

Bourgeois, B.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract



Sponsored by the Naval Research Laboratory.

Presented at Technology Transfer Exhibits, 1004/010G.
Conference Proceedings

(Bourgeois)

NAVAL RESEARCH LABORATORY BRIEF TO ADM SOBRAL

Bourgeois, B. Avera, W. Harris, M.
Bibee, L. Sample, J. Holland, K. T.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004
Lingsch, S.
Naval Oceanographic Office
Stennis Space Center, MS 39529-5004

Abstract

Brief:

- Adaptive Navigation For Swath Sensors
- By Brian Bourgeois of the Naval Research Laboratory (NRL)
- 24 Pages

Brief:

- Multibeam Bathymetry From A Mine-Hunting Military Sonar
- By Will Avera, Michael Harris, Dale Bibee, John Sample of NRL and Steve Lingsch of the Naval Oceaographic Office
- 6 Pages

Brief:

- Quantification Of SurfZone Processes Using Motion E/O Imagery
- By K. Todd Holland of NRL
- 34 Pages

Sponsored by the Naval Research Laboratory.

Presented at the Naval Research Laboratory Brief to ADM Sobral, March 12, 2002, Stennis Space Center, MS.
Naval Research Laboratory Contribution Number NRL/OP/7440–02-1004.
Oral Presentation
64 Pages

(Bourgeois)

SHIPBOARD WAVE MEASUREMENT SYSTEM

Martinez, A.
Tulane University
New Orleans, LA 70118
Bourgeois, B.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

The Shipboard Wave Measurement System (SWMS) enables direct measurement of the height, direction, wave length and period of waves from a moving surface or subsurface vessel. At sea tests indicate better than 1% agreement with wave-rider buoy measurements.

Sponsored by the Oceanographer of the Navy.

Patented, May 7, 2002
Patent Number 6382022
Navy Case Number 80, 121
NRL Patent

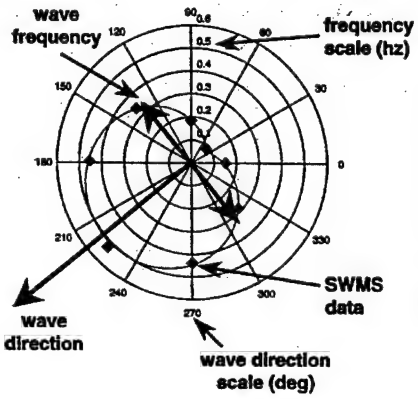
(Bourgeois)

SHIPBOARD WAVE MEASUREMENT SYSTEM (SWMS)

Bourgeois, B.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

SHIPBOARD WAVE MEASUREMENT SYSTEM (SWMS)



Results from Sea Trial (14 Aug 98)

	Wave-rider Buoy	SWMS
Wave Direction:	225°	226°
Wave Period:	3.08 sec	3.08 sec
Wave Length:	n/a	28.6 m

The Naval Research Laboratory has developed the Shipboard Wave Measurement System (SWMS) for direct measurement from a moving surface or subsurface vessel of the height, direction, wave length and period of waves. Tests at sea indicate good agreement (within 1%) with measurements by wave-rider buoys, the currently used technology.

Advantages include:

- Accurate, yet rapid, wave and current measurement
- Allows measurement at location of interest, not restricted by placement of Government agency's buoys
- No off-board equipment required
- Operable on any surface or subsurface vessel

Applications include:

- Oceanographic surveys
- Off-shore construction or diving
- Salvage operations

Points of Contact
Naval Research Laboratory
4555 Overlook Avenue, SW, Washington, DC 20375-5320

Dr. Catherine Cotell • Head, Technology Transfer Office • (202) 767-7230
Dr. B. Bourgeois • Marine Geosciences Division • (228) 688-5321 • bsb@nrlssc.navy.mil

Sponsored by the Naval Research Laboratory.
Presented at Technology Transfer Exhibits, 1004/009G.
Conference Proceedings

(Bourgeois)

SHIPBOARD WAVE MEASUREMENT SYSTEM (SWMS)

Bourgeois, B.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

Purpose: Measurement of wave height, direction, wave length and frequency from a moving vessel.

Application: Surface vessels and submersibles

Technique:
• Rapid sampling of range to sea surface
• Geometric correction of measured range for pitch, roll and correction of heave and vertical offset using a complementary filter
• Estimation of dominant wave-front observed frequency
• Estimation of wave parameters using least squares methods given observed frequencies and vessel positions

Sponsored by the Oceanographer of the Navy via SPAWAR PMW 155.

Presented to the National Research Council Canada.
Naval Research Laboratory Contribution Number NRL/OP/7440–01-1010.
Oral Presentation
6 Pages

(Bourgeois)

UUV NAVIGATION

Bourgeois, B.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

- Modification of LOST (Localization of a Submerged Towbody) system for use with untethered vessels.
- A cost-effective approach to accurate underwater vessel positioning when high-resolution bathymetry is available.
- Uses standard low-cost UUV sensors
- LOST2 non-linearly combines:
  - Dead-Reckoning
  - Acoustic based positioning
  - A new single point terrain matching method

Sponsored by the Office of Naval Research.

Presented at the TTCP Technical Panel 13 Meeting, October 24, 2001, Stennis Space Center, MS.
Naval Research Laboratory Contribution Number NRL/OP/7440–01-1009.
Oral Presentation
27 Pages

(Bourgeois)

UUV TASK FORCE PNT
(POSITION, NAVIGATION AND TIMING)

Bourgeois, B.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

Project Objectives:

- Gravity Aiding INS
- Robust Bottom Feature Detection
- Inter-Vessel PNT
    - Identify Formation PNT Tasks
    - Develop Approaches/Algorithms
    - Computer Simulation
    - Robot Simulation

Sponsored by the Office of Naval Research.

Presented at the NAVSEA Seminar, June 18, 2002, Washington, DC.
Naval Research Laboratory Contribution Number NRL/OP/7440–02-1011.
Oral Presentation
37 Pages

(Bourgeois)

UUV TEAMS FOR DEEP WATER OPERATIONS

Bourgeois, B.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

This presentation is about the Unmanned Underwater Vessel (UUV) team concept, and discusses the goals of a new research effort at the Naval Research Laboratory (NRL) to develop the technologies required to implement this concept. The UUV team concept is essential to rapid and covert near-shore military operations where a communication and navigation infrastructure is not available. The UUV team concept also has the potential for lowering the cost of deep-water commercial operations and could eliminate the need for tethered vessels in some scenarios.

Sponsored by the Office of Naval Research.

Published on CD. Presented at the Underwater Intervention 2002 Conference, February 28, 2002, New Orleans, LA.
Naval Research Laboratory Contribution Number NRL/OP/7440–02-1002.
Oral Presentation
24 Pages

(Bourgeois)

UUV TEAMS FOR DEEP WATER OPERATIONS

Bourgeois, B. McDowell, P.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

This paper presents the Unmanned Underwater Vessel (UUV) team concept, and discusses the goals of a new research effort at the Naval Research Laboratory (NRL) to develop the technologies required to implement this concept. The UUV team concept is essential to rapid and covert near-shore military operations where a communication and navigation infrastructure is not available. The UUV team concept also has the potential for lowering the cost of deep-water commercial operations and could eliminate the need for tethered vessels in some scenarios.

Sponsored by the Office of Naval Research.

Presented at the Underwater Intervention 2002 Conference, February 27-March 2, 2002, New Orleans, LA.
Naval Research Laboratory Contribution Number NRL/PP/7440–01-1015.
Conference Proceedings
6 Pages

(Bourgeois)

WAVIMETER

Martinez, A.
Tulane University
New Orleans, LA
Bourgeois, B.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

A method of extracting wave parameters from wave height measured from a moving platform is presented. A least squares approach is presented to estimate wave parameters using vessel velocity and perceived wave frequency that eliminates Doppler due to vessel motion. Two techniques for estimating wave frequency are presented: a block data method using MUSIC and a real-time method using demodulation. Sea trial results demonstrate that this method is as effective as a WaveRider buoy for estimating wave parameters.

Sponsored by the Office of Naval Research.

Presented at the Oceans 2002 Conference, October 29-31, 2002, Biloxi, MS.
Naval Research Laboratory Contribution Number NRL/PP/7440--02-1021.
Conference Proceedings
6 Pages

(Brandon)

AUTOSURVEY: CURRENT INTEGRATION AND THE AUTOSURVEY PLANNER

Brandon, D. Bourgeois, B.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

This paper introduces AutoSurvey, an environmentally adaptive approach to hydrographic surveys, and explains how this new technology can benefit the industry. Also, the paper describes the platforms it has been tested on, and describes the current integration effort of AutoSurvey into NAVOCEANO's Integrated Survey System, ISS-60. The AutoSurvey Planner, a new project being developed to bring AutoSurvey functionality to survey planners, is introduced. Results of various simulation runs are presented that demonstrate AutoSurvey's ability to dramatically reduce survey time.

Sponsored by SPAWAR.

Presented at the Oceans 2002 Conference, October 29-31, 2002, Biloxi, MS.
Naval Research Laboratory Contribution Number NRL/PP/7440—02-1024.
Conference Proceedings
7 Pages

(Breckenridge)

CHARACTERIZATION OF THE DYNAMIC LITTORAL ZONE AN EXERCISE IN THE REAL-TIME DYNAMICS OF SPATIAL DATA INTEGRATION

Breckenridge, J. Shaw, K. Ladner, R.
Wilson, R. Holland, K. T.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

The National Imagery and Mapping Agency (NIMA) has established "Phase 1 Proof-of-Concept Demonstration for an Integrated Interagency Characterization of the Littoral Zone" under the program direction of Chung Hye Read. The purpose of this task was to examine and demonstrate advanced spatial database techniques that allow for the efficient and timely integration of large spatial databases relative to Littoral "Areas of Interest (AOI)." To accomplish this effort, the Naval Research Laboratory's Digital Mapping, Charting & Geodesy Analysis Program (DMAP) expanded its Geospatial Information Database (GIDB), an object-oriented database system, to handle the Littoral-zone dynamics which tend to be highly variable in both the temporal and spatial domains. GIDB stores this data with large quantities of topographic, navigational, and cultural features data, to offer a high-resolution digital representation of both wet and dry environments within the coastal regions.

This paper examines the Naval Research Laboratory's (NRL) initiative to develop a geospatial Characterization of the Dynamic Littoral Zone (CDLZ). Through this effort, methods were investigated for identifying and collecting digital spatial data from multiple sources, including government, academia, and the private sector. Described are steps taken to identify and collect the data and the processes used to persist these data entities within NRL's GIDB. The GIDB offers a unique framework for facilitating efforts of data compilation and AOI representation for specialized missions. Through its object-oriented data model, GIDB can provide spatial data entities that are functionally capable of representing the dynamics of the littoral region. The environmental, cultural, hydrographic and oceanographic features are more consistent with their real world counterparts. The GIDB also offers a unique way of blending complex temporal data sets with other environmental data and even rendering that information using 3-Dimensional viewing tools within the context of a common Web-Browser as depicted in the preceding illustration.

The efforts presented focus upon the region surrounding the U.S. Army Corps of Engineers Field Research Facility (FRF) at Duck, North Carolina. The Duck facility was chosen because it offers both an extremely dynamic littoral region, while also providing detailed and substantial data archives of nearshore measurements. Through this effort, the NRL will refine processes for compiling the information necessary to digitally portray and analyze the complexity and dynamics of coastal/nearshore environment. It is further anticipated that the experience gained and methods refined through development of this CDLZ are applicable to data integration efforts in other regions of the world.

Sponsored by the Oceanographer of the Navy via SPAWAR PMW 185.
Presented at the Southern Conference On Computing, October 26-28, 2000, Hattiesburg, MS.
Naval Research Laboratory Contribution Number NRL/PP/7440–00-1013.
Conference Proceedings

(Breckenridge)

DRAFT - CONCEPTS OF OPERATION FOR THE CD-GRASS GIS TEAM

Breckenridge, J. Mesick, H. Carter, S. Shaw, K.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004
Cobb, M.
University of Southern Mississippi
Hattiesburg, MS
Petry, F.
Tulane University
New Orleans, LA
Lovitt, T.
Planning Systems, Inc.
Slidell, LA
Thomas, M. Goss, H.
National Guard Bureau-CounterDrug Offices
Atlanta, GA
Higgins, M. Faust, N.
Georgia Technical Research Institute
Atlanta, GA

Abstract

The GIS Team will facilitate the development of a CD-GRASS Design Document through a team structure that identifies the functional requirements and a preliminary data model for the CD-GRASS.

Sponsored by the National Guard Bureau-CounterDrug Office.

Presented to the National Guard CD-GRASS GIS Team, June 7, 2001.
Naval Research Laboratory Contribution Number NRL/PO/7440–01-1001.
Proceedings of Other Than a Professional Society
17 Pages

(Breckenridge)

EXPANDING THE NAVY'S GEOSPATIAL INFORMATION DATA BASE (GIDB)

Breckenridge, J.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004
Beaubouef, T.
Southeastern Louisiana University
Hammond, LA 70402

Abstract

Research efforts continue to enhance the ability of environmental sensors to collect hydrographic data at faster rates and at much higher levels of accuracy. Subsequently data volumes continue to increase and become significantly more difficult to review, analyze, and evaluate during the collection process. Quality assessment of this data, which most frequently occurs in a post-processing mode, remains one of the key factors of delay in delivering new spatial information to the end-user. Manipulating and assessing the data during the collection process can accelerate and improve the data delivery process (Bourgeois, 1999). Likewise, the application of a Geographic Information Systems (GIS) based Object-Oriented (OO) Paradigm at the point of data collection offers added benefits to quality assessment techniques in the early life cycle of hydrographic information. In this document, hydrographic survey requirements for such a data model are addressed in support of the Naval Oceanographic Office (NAVOCEANO). The enhancement of the Naval Research Laboratory's Geospatial Information Data Base for hydrographic applications, referred to as **GIDB-Hydro**, offers a direct means of meeting these requirements. This paper addresses 1) NAVOCEANO's immediate need for integrating an OO-Data Base Management System within its Integrated Survey System (ISS-60); and 2) it's ability to utilize GIDB-Hydro in conjunction with commercial off-the-shelf (COTS) GIS to support NAVOCEANO's generation of specialized oceanographic information products.

Sponsored by the Oceanographer of the Navy.

Published in the *Journal of Integrated Coastal Zone Management*, February 2000 Edition.
Naval Research Laboratory Contribution Number NRL/JA/7440–00-0001.
Journal Article

(Breckenridge)

GIS DAY 2002 – WHAT IS GIS?

Breckenridge, J. Harris, M.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

GIS – Geographic Information Systems offer computer-based tools and scientific methods for managing the use of geospatial data.

Sponsored by SPAWAR.

Presented at the GIS Conference, November 20, 2002.
Naval Research Laboratory Contribution Number NRL/PT/7440–02-1004.
Poster
6 Pages

(Breckenridge)

NATIONAL IMPLEMENTATION PLAN – LEA IT CENSUS PHASE I OF THE DATABASE FOR ASSESSMENT OF REQUIREMENTS AND TACTICS (DART)

Breckenridge, J. Mesick, H.
Carter, S. Shaw, K.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004
Lovitt, T.
Planning Systems, Inc.
Slidell, LA

Abstract

Phase I of the Database for Assessment of Requirements and Tactics (DART) offers the National Guard Bureau Counterdrug (NGB-CD) Office a 'Survey Research' based method of determining the Information Technology (IT) capabilities of Law Enforcement Agents (LEA) involved in counterdrug operations. This document defines a region-based strategy for deploying the DART IT Census. The Counterdrug Coordinator (CDC) located in each of the 50 states and 4 commonwealth areas serves as the central point of contact for deploying this IT Census. This Implementation Plan (IP) directs all function of the DART Phase I IT Census to be executed at the CDC level. The deployment of the Mississippi LEA Census will be used as a 'Pilot Test' [1] to determine the effectiveness of this IP.

Note: Web Page Review Included
http://gidb.nrlssc.navy.mil/dart.html

Sponsored by the National Guard Bureau-CounterDrug Directorate.

Published as a Naval Research Laboratory Memorandum Report, September 14, 2001.
Naval Research Laboratory Contribution Number NRL/MR/7440–01-8267.
NRL Memorandum Report
16 Pages

(Breckenridge)

NAVAL DMAP GIDB PORTAL SYSTEM

Breckenridge, J. Shaw, K.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

The Naval Digital Mapping, Charting and Geodesy (MC&G) Analysis Program (DMAP) Team at the Naval Research Lab, Stennis Space Center, MS has conducted basic and applied research in areas related to object oriented (OO) spatial database technology to support Navy and Marine Corps missions since 1994. Significant develop of an OO spatial database framework has led to the parallel development of geospatial tools and a graphical user interface to help demonstrate the advantages of this framework. The GIDB™ Portal offers direct, interoperable connection and integration of various disparate geospatial databases utilizing server-based connectivity over the Internet. The GIDB is intended to support geospatial data aspects of missions that include Naval Operations and Warfare, Emergency Management, Homeland Defense and Facilities Planning/Management. The GIDB also currently serves as the digital framework for distributing geospatial data to operational forces through the National Imagery and Mapping Agency's (NIMA) Gateway.

Sponsored by SPAWAR.

Presented at the Oceans 2002 Conference, October 29-31, 2002, Biloxi, MS.
Naval Research Laboratory Contribution Number NRL/PT/7440—02-1002.
Poster
3 Pages

(Breckenridge)

NAVAL RESEARCH LABORATORY-STENNIS SPACE CENTER SUPPORT TO NATIONAL GUARD BUREAU-COUNTERDRUG DIRECTORATE

Breckenridge, J.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

The Naval Research Laboratory, Stennis Space Center (NRLSSC) is supporting the National Guard Bureau-CounterDrug Directorate (NGB-CD) in transitioning advanced techniques for spatial analysis and data integration using commercial off the shelf and government Geographic Information Systems (GIS) technology. NRLSSC is the primary technical representative to NGB-CD for the design and development of the Database for Assessment of Requirements and Tactics (DART). Utilizing leading edge technology, NRLSSC will develop the DART to serve three major functions including 1) an Interactive Interviewing Tool to assist CD Coordinators (CDC)/Law Enforcement Agents (LEA), 2) a CDC Tactical Planner/State Plans Development Tool, and 3) a Digital Mapping Initiative (DMI) Spatial Data Integrator.

NRLSSC's DART development efforts will directly support the CounterDrug-Geographical Regional Assessment Sensor System (CD-GRASS) by providing a prototype tool for assessing national CD assets and identifying DLEA requirements/resources for spatial information. NRL will assist NGB-CD and Georgia Tech. Research Institute (GTRI) in drafting a technical schema for the CD-GRASS. It will further serve to assist them in examining the benefits of introducing new technology (e.g. Object-Oriented Geospatial Information DataBase (GIDB)) into the CD-GRASS development cycle.

Likewise, NRLSSC will provide technical advisory and developmental support to the GIS Training (GIST) tasks as requested by NGB-CD. Together, the DART and the GIDB offer a unique multi-media experience in utilizing GIS technology. The ability of these systems to offer a technical forum for GIS instruction via World Wide Web-based tools offer a means of minimizing NGB-CD's need for duplicating GIST instruction facilities on a national basis. NRLSSC can provide NGB-CD with technical concepts for developing GIST as a national collection of geospatial assets that include intra/inter-state partnerships fostering the sharing of data, tools, and advanced GIS techniques. These concepts further encourage an ongoing advancement of NGB-CD technical resources (i.e. Digital Mapping Initiative) to ensure its long-range ability to implement immerging GIS technology in the CD mission. This approach will include mechanisms to integrate the benefits of regional development initiatives like the Mississippi Cannabis Eradication Decision Support System (MCEDSS) to alleviate problems of sharing digital information across political and jurisdictional boundaries.

NRLSSC is pursuing an aggressive interest in the development of GIS-based tools and resources to support the NGB-CD in its efforts to reduce the national impacts of illegal drug production, manufacture and distribution. GIS technology available at NRLSSC offers a unique way of providing force multiplication to CD LEA. The technical relationship between NGB-CD and NRLSSC fosters a unique point of leverage for increasing the LEA's ability to fulfill the CD mission by taking full advantage of the latest technological advancements in spatial analysis and Information Technology (IT).

The Marine GeoSciences Division, Code 7400 of NRLSSC has responsibility for planning and executing a broad-spectrum research, development, and technology program in marine geology, geophysics, geoaccoustics, geotechniques, and mapping, charting, and geodesy (MC&G). The program is designed to provide necessary digital databases, geoacoustic and geophysical models, and simulations to support training, system design, performance prediction, and operational needs of the Navy.

The Division serves as the focal point in the Navy and Marine Corps for assessing and identifying MC&G requirements, including prototype digital MC&G products and product coordination. The program is keyed to and responsive to priorities identified by NRL, the Office of Naval Research (ONR), the Chief of Naval Operations (CNO), Navy System Commands, and the National Imagery and Mapping Agency (NIMA). CNO, ONR and NIMA further recognize NRLSSC as the Navy's "Lead Laboratory for Mapping, Charting & Geodesy".

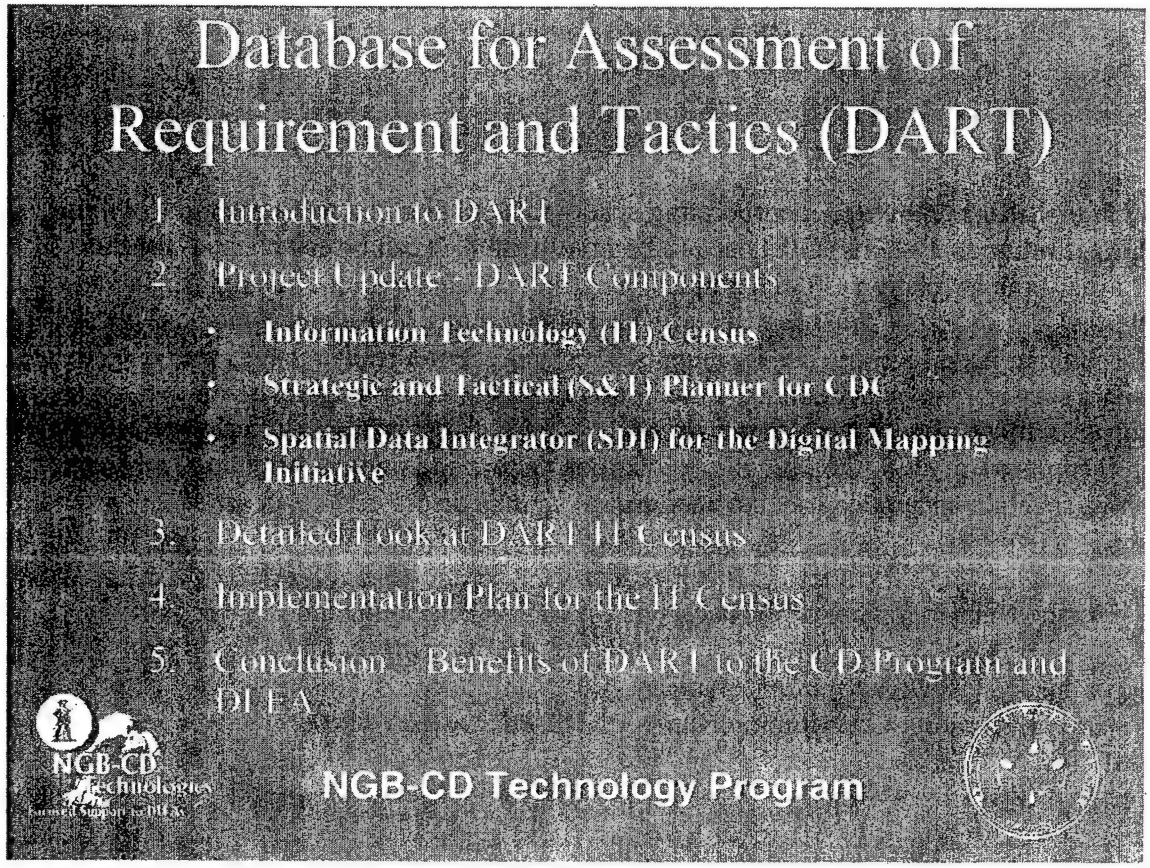
Sponsored by the National Guard Bureau-CounterDrug Directorate.
Published at the National Guard GIS Techonolgy Symposium, April 27, 2000.
Naval Research Laboratory Contribution Number NRL/OP/7440—00-0005.
Conference Proceedings

(Breckenridge)

NGB-CD TECHNOLOGY PROGRAM – INCLUDING 3 POSTERS

Breckenridge, J.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract



Sponsored by the National Guard Bureau.

Presented at the Counter Drug Coordinator Conference, March 26-29, 2001.
Naval Research Laboratory Contribution Number NRL/OP/7440–01-1003.
Oral Presentation

(Breckenridge)

REAL-WORLD ISSUES AND APPLICATIONS FOR REAL-TIME GEOGRAPHIC INFORMATION SYSTEMS (RT-GIS)

Beaubouef, T.
Southeastern LA University
Computer Science Department
Hammond, LA 70402
Breckenridge, J.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

Many of the issues relative to incorporating spatial information in a real-time mode within geographic information systems (GIS) need to be investigated. It can be established that the concept of real-time in relation to the input, analysis, display, and output of complex spatial information is directly dependent upon specific user applications. This dependency has been evident throughout Naval Research Laboratory's development of a real-time GIS for hydrographic survey. This paper contrasts the issues and requirements observed for this application with those of vector moving map displays for high-speed aeronautical applications. Finally it attempts to quantify the influence of various factors and impacts affecting real-time response to a specialized application like vector moving map displays.

Sponsored by the Oceanographer of the Navy via the SPAWAR Command.

Published in the *Journal of Navigation,* January 2000.
Naval Research Laboratory Contribution Number NRL/PP/7441–99-0007.
Journal Article

(Breckenridge)

ROUGH SET BASED UNCERTAINTY MANAGEMENT FOR SPATIAL DATABASES AND GEOGRAPHICAL INFORMATION SYSTEMS

Beaubouef, T.
Southeastern LA University
Computer Science Department
Hammond, LA 70402
Petry, F.
Tulane University
New Orleans, LA 70118
Breckenridge, J.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

Uncertainty management is necessary for real world applications. This especially holds true for database systems. Spatial data and geographic information systems in particular require some means for managing uncertainty. Rough set theory has been shown to be an effective tool for data mining and for uncertainty management in databases. This paper addresses the particular needs for management of uncertainty in spatial data and GIS and discusses ways in which rough sets can be used to enhance these systems.

Sponsored by the Oceanographer of the Navy via the SPAWAR Command.

Published in the Soft Computing In Industrial Applications Book, March 2000.
Book Chapter

(Breckenridge)

THE DATABASE FOR THE ASSESSMENT OF REQUIREMENTS AND TACTICS (DART) PHASE I: DEVELOPMENT OF A WORLD WIDE WEB-BASED INFORMATION TECHNOLOGY (IT) CENSUS

Breckenridge, J.
McCreedy, F.
Shaw, K.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004
Perniciaro, R.
Planning Systems, Inc.
Slidell, LA

Abstract

The DART establishes an online method of examining the current Information Technology (IT) resources of LEA throughout the United States. The DART interviewing tool uses the World Wide Web as a delivery vehicle for conducting a direct census of LEA involved in counter-drug operations. By establishing a baseline understanding of current LEA IT resources, the DART can assist in determining nationwide resource requirements for the deployment of the CD-Geographic Regional Assessment Sensor System (CD-GRASS). Deficiencies in local LEA resources can be identified and addressed by the regional CounterDrug Coordinator (CDC) in an appropriate timeframe to avoid significant impacts upon the deployment of the CD-GRASS.

Sponsored by the National Guard Bureau – Counterdrug Directorate.

Published as a Naval Research Laboratory Memorandum Report, September 29, 2000.
Naval Research Laboratory Contribution Number NRL/MR/7440–00-8246.
NRL Memorandum Report
10 Pages

(Carter)

DMAP TECHNICAL REVIEW DLA ELECTRONIC CATALOG OF NIMA PRODUCTS PROTOTYPE 1

Carter, S. Mesick, H. Breckenridge, J.
Trenchard, M. Shaw, K.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

Automating the selection and ordering process for digital and hardcopy Mapping, Charting and Geodesy (MC&G) products provided by the National Imagery and Mapping Agency (NIMA) is expected to simplify and accelerate a previously complex task. The replacement of a voluminous paper catalog with a geo-spatially oriented CD-ROM interface should facilitate the user's ability to identify an area-of-interest, select appropriate data products and initiate a formal request to the Defense Logistics Agency (DLA). The development of this CD-ROM-based catalog would also provide a technical basis for encouraging future efforts for hosting this information in an on-line mode on the World Wide Web or in a secure network environment. Toward these efforts, DLA recently presented an "Electronic Catalog of NIMA Products Prototype 1" for technical review. This potentially effective blend of multimedia materials, advanced database techniques and Geographic Information System (GIS) technology meets much of its intended purpose of eliminating the paper stack currently required to catalog NIMA products. As the Navy's lead laboratory in MC&G, the Naval Research Laboratory (NRL) recently examined this prototype in response to a formal request of evaluation from the Oceanographer of the Navy (N096). The results and key points of that evaluation are presented within this document.

Sponsored by the Oceanographer of the Navy via the SPAWAR Command.

Published as a Naval Research Laboratory Memorandum Report, February 22, 2001.
Naval Research Laboratory Contribution Number NRL/MR/7440–01-8257.
NRL Memorandum Report

(Chung)

ADDING THE THIRD DIMENSION TO DIGITAL MAPPING

Chung, M. Ladner, R. Wilson, R.
Breckenridge, J. Shaw, K.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

The Digital Mapping, Charting & Geodesy Analysis Program (DMAP) at the Naval Research Laboratory has been developing the distribution of geographic data over the Web through its Geospatial Information Database. While this work has primarily included digital mapping information from a variety of formats, DMAP has also been working on 3D synthetic environment data delivery. This chapter describes DMAP's work to provide a three-dimensional representation of geographic data. We provide an overview of the data structures used to reconstruct 3D synthetic environments and to store full 3D topology. We also describe a prototype that supplements traditional 2D digital-mapping output with a 3D interactive synthetic environment.

Sponsored by the National Imagery and Mapping Agency and the U.S. Marine Corps Warfighting Lab.

Published in the 3-D Synthetic Environment Reconstruction From Start To Finish, Kluwer Publication Book, April 2001.
Naval Research Laboratory Contribution Number NRL/BA/7440--00-1002.
Book Chapter 3
Pages 61-73

(Chung)

CHARACTERIZATION OF THE LITTORAL ZONE

Chung, M. Wilson, R. Holland, K. T.
Breckenridge, J. Shaw, K.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004
Reed, C. Dale, J.
National Imagery and Mapping Agency

Abstract

The US National Imagery and Mapping Agency (NIMA) has established a requirement to characterize the dynamic oceanographic littoral environment. In meeting this requirement, it was necessary to examine and demonstrate advanced spatial database techniques that allow for the efficient and timely integration of large spatial databases relative to Littoral Areas of Interest (AOI). To accomplish this effort, the Naval Research Laboratory's Digital Mapping, Charting & Geodesy Analysis Program (DMAP) has expanded the Geospatial Information Database (GIDB), an object-oriented database system, to handle the Littoral-zone dynamics. GIDB stores this data, along with large quantities of topographic, navigational, and cultural features data, to offer a high-resolution digital representation of both wet and dry environments within the littoral zone including handling of temporal aspects of the region. This paper will consist of two phases: the data collection and requirement phase, and collected data integration to the GIDB.

The data collection phase began by examining Navy/Marine Corps' recent re-focus from a predominantly global threat to one of regional challenges and opportunities, (Kelso and Mundy, 1992) most often concentrating upon the complex operating environment of the littoral or coastlines of the earth. To parallel naval operational planning policies, NRL identified and collected data holdings based upon three scales of data resolution (e.g. 6, 100, and 250 nautical miles) surrounding a geographic point located at the Duck, N.C. Field Research Facility. Each of the data sets were geographically clipped to one of these boundaries and stored within the GIDB as persistent objects. The primary contents of the littoral GIDB include DNC w/VPF modifications, Elevation, Bathymetry and Topographic/Cultural Features Surveys, Dynamic Ocean Features Data, and any associated meta-data. Since these data were collected from a host of government, academic, and private industry sources, utilization of the GIDB offers a unique opportunity for supporting a wide range of end-user applications.

The GIDB consists of an object-oriented database system and online spatial data dissemination via a web browser. Due to the complex nature of spatial data, an object-oriented technology was selected to implement the integration of geospatial data. (VPF), Raster Product Format (RPF), and Text product Standard (TPS), ESRI's Shape format, Naval Oceanographic Office's Generic Sensor Format, and ASCII format, to name a few. As the object-oriented technology gains the support of industry and database vendors, an environment for interoperability among programming languages and platforms is realized through the Common Object Request Broker Architecture (CORBA). Such interoperability allows a system with server code developed in Smalltalk on Unix Solaris machine to have Java servlet/applet clients that can be viewed using any web browsers. GIDB is more than a simple visualization tool. It also provides simple GIS fuctionalities based on the Area-of-Interest, such as spatial analysis, Internet search, dynamic updating capability, and download of exported VPF data over the AOI option. The littoral region is characterized by its dynamic or time-varying data. GIDB allows an integration of spatial and temporal data. Furthermore, due to the dynamic nature and the detailed display requirement, a 3D visualization is rendered on a web browser using a freeware COSMOS plug-in. A system architecture and detailed description of the GIDB is presented in the paper.

Sponsored by the National Imagery and Mapping Agency.

Presented at the International Geographic Congress Conference, August 14-18, 2000, Seoul, Korea.
Naval Research Laboratory Contribution Number NRL/AB/7441--00-0004.
Abstract

(Chung)

GEOSPATIAL INFORMATION DATABASE IN SUPPORT OF URBAN WARRIOR EXERCISE

Chung, M. Wilson, R. Ladner, R. Shaw, K.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

The Mapping, Charting, and Geodesy Branch participated in the Urban Warrior Advanced Warfighting Experiment in March 1999. The Marine Corps Warfighting Laboratory (MCWL) funded NRL to support an Integrated Marine Corps Multi-Agent Command and Control System (IMMACCS) by using the Geospatial Information Database (GIDB) as one of its components. GIDB demonstrated an ability to actively manage National Imagery and Mapping Agency (NIMA) mapping data in an object-oriented manner that could be interfaced with components developed by Stanford Research Institute (InCon), California Polytechnic Institute (Intelligent Agents), and NASA's Jet Propulsion Laboratory (SharedNet). The GIDB demonstrated that this integrated database could be viewed and engaged by area-of-interest via a simple Internet browser. The GIDB served primarily as the focal handling point for geospatial information. Additionally, privileged users, known as data co-producers, were given the ability to perform remote updates on the geospatial data in the GIDB.

Sponsored by the Marine Corps Warfighting Laboratory as part of the Urban Warrior Advanced Warfighting Experiment under Program Element 63640M.

Published in the *Naval Research Laboratory Review,* June 2000.
Naval Research Laboratory Contribution Number NRL/PU/5211—00-399.
Journal Article

(Chung)

MINE WARFARE TECHNICAL ARTICLE

Chung, M. Shaw, K. Wilson, R.
Ladner, R. Breckenridge, J. McCreedy, F.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

The Geospatial Information Database (GIDB) is an implementation of ongoing research in object-oriented geographic data modeling at the Naval Research Laboratory's Mapping, Charting & Geodesy Branch. The GIDB has evolved over the last six years from an initial memory-resident application involving vector mapping data. The current state-of-the-art system offers a distributed object-oriented database with web-based viewing capabilities for vector, raster, hypertext and multimedia data, as well as remote updating of vector data.

Sponsored by the Office of Naval Research.

Published in the NSAP Newsletter in Summer 2000.
Proceedings (Newsletter Article)

(Chung)

THE GEOSPATIAL INFORMATION DISTRIBUTION SYSTEM (GIDS) FOR 2D AND FULL 3D TOPOLOGY MAPPING

Chung, M. Wilson, R. Ladner, R. Shaw, K.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004
Lovitt, T.
Planning Systems Inc.
Slidell, LA 70458
Cobb, M.
University of Southern Mississippi
Hattiesburg, MS 39406-5106
Abdelguerfi, M.
University of New Orleans
New Orleans, LA 70148

Abstract

This paper shows how a web-based distributed system for retrieval and updating of mapping objects was implemented, the GIDS. The GIDS architecture relies heavily upon object technology and includes: a Smalltalk server application interfaced to a Gemstone ODBMS, Java/applet-based client applications, and CORBA middleware in the forms of VisiBroker and GemORB. The GIDS was the realization of our goal to have NIMA data available for electronic information distribution and updating, and played a significant role in the Marine Corps Warfighting Lab's Urban Warrior Advanced Warfighting Experiment in the spring of 1999. The architectural components of the system worked well together; using Smalltalk as the server development environment allowed us to quickly prototype new capabilities, while Java provided the web-based capabilities for the user interface. CORBA proved an excellent choice to serve as a bridge between the two.

A description and prototype of 3D synthetic environment using VPF+ is also discussed. The 3D developments demonstrated how marines could utilize this technology for improved situational awareness and mission planning. Users have the ability to view the environment in a more realistic manner. VPF+ is the vehicle that allowed the synthetic environment to be constructed with topology in tact. Furthermore, such 3D visualization is web enabled through the web browser plugins. Future direction consists of bridging the gap between the 2D and 3D by allowing 3D rendering from the GIDS's 2D display.

Sponsored by the Marine Corps Warfighting Laboratory as part of the Urban Warrior Advanced Warfighting Experiment under Program Element 63640M.

Published in Objects at Work, October 2000.
Naval Research Laboratory Contribution Number NRL/BA/7441—00-0001.
Book Chapter

(Chung)

QUERYING MULTIPLE DATA SOURCES VIA AN OBJECT-ORIENTED SPATIAL QUERY INTERFACE AND FRAMEWORK

Chung, M. Wilson, R. Shaw, K.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004
Petry, F.
Tulane University
New Orleans, LA 70118
Cobb, M.
University of Southern Mississippi
Hattiesburg, MS 39406-5106

Abstract

A spatial query model has been designed and implemented for heterogeneous data sets in the object-oriented paradigm. The object-oriented approach presented is shown to be highly suitable for querying typical multiple heterogeneous sources of spatial data. The spatial query model takes into consideration two common components of spatial data: spatial location and attributes. Spatial location allows users to specify an area or a region of interest, also known as a spatial range query. Also, the spatial query allows users to query spatial orientation and relationships (geometric and topological relationships) among other spatial data within the selected area or region Queries on the properties and values of attributes provide more detailed non-spatial characteristics of spatial data. A query model specific to spatial data involves exploitation of both spatial and attribute components. This paper presents a conceptual spatial query model of heterogeneous data sets based on the object-oriented data model used in the Geospatial Information Distribution System (GIDS).

Sponsored by the U. S. Marine Corps and SPAWAR PMW 185.

Published in the Special Issue of the *Journal of Visual Languages and Computing,* 2001.
Naval Research Laboratory Contribution Number NRL/JA/7441–00-0018.
Journal Article 12
Pages 37-60

(Edwards)

MILITARY APPLICATION OF COMMERICAL NAVIGATION PRODUCTS

Edwards, S. Gendron, M. Mang, R. Trenchard, M.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

In times of rapidly advancing technology, military application of commercial products has become increasingly popular in the United States. One area of commercial technology that is particularly well suited to support military operations is commercial GPS systems. Commercial GPS systems can be found virtually anywhere in the United States. There are several developers that produce quality systems, and they are available through the manufacturer's web sites, magazines, marine stores, and even in your local electronics store. The available commercial products are compatible with National Imagery and Mapping Agency (NIMA) and National Oceanic & Atmospheric Administration (NOAA) charts, and are very simple to load with mission specific data. The U.S. Navy and Marine Corps realize that is not economically feasible to develop an accurate, compact means of precise navigation for each of the many different systems and mission objectives that exist. With GPS systems evolving quickly, and with many different commercial vendors competitively striving to improve their individual products, the Navy and Marine Corps have tasked the Naval Research Laboratory (NRL) to investigate the adaptation and suitability of commercial GPS devices for precise lane navigation.

Because of the growing needs of the military to be able to precisely navigate in a variety of conditions, the NRL was approached to investigate, develop, and demonstrate systems to electronically display precise lane navigation information in order to guide military landing craft drivers through an assigned lane to the beach during an amphibious assault in the presence of mines. In order to create the best demonstration product with the funding available, NRL has decided to use commercial GPS products. The reasons for this decision were based upon price, availability, reliability, and accuracy. Hardware that NRL is planning to test include:

- Data Automated Communications Terminal (DACT)
- Laptop computer
- The integrated multifunctional control system used on the Advanced Amphibious Assault Vehicle (AAAV)
- Navstar 1000, a new product designed by Navigator PC.

Although the U.S. government has ended their policy of using selective availability, there are still times when can and will be activated. However, the military has the means to overcome this, and for most applications, the commercial GPS receivers are fully capable to meet the navigational needs of the military.

NRL is also in the process of developing software to compress different map types and imagery into the Raster Product Format (MIL-STD-241 1) (RPF). This will allow bathymetry data, nautical charts, and satellite and acoustic imagery to be loaded on devices that handle standard NIMA RPF data. NRL is determining methods of loading mission specific overlays, such as threat rings, lane markings, possible mine-like objects, and waypoints.

Sponsored by the Office of Naval Research.

Presented at the ION GPS 2002 Conference, September 24-27, 2002, Portland, Oregon.
Naval Research Laboratory Contribution Number NRL/PP/7440—02-1001.
Conference Proceedings
1 Page

(Elmore)

CAVITY AND FLOW STUDIES OF REPRODUCIBLE BUBBLE ENTRAINMENT EVENTS ASSOCIATED WITH RAIN

Elmore, P.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004
Chahine, G.
Dynaflow Inc.
Fulton, MD 20759
Oguz, H.
Johns Hopkins University
Baltimore, MD 21218

Abstract

Rain contributes to the introduction of air into the sea by creating bubbles after impact. Some of these events, particularly from drops 0.8–1.2 mm in diameter, create bubbles reproducibly by a process called regular entrainment. To better understand the mechanics that creates the bubble, kinematic measurements of the cavities formed during regular entrainment events are examined from high-speed motion pictures and are compared with available computational methods. Experimental and numerical results agree with each other on the overall shape of the interface and the occurrence of bubble detachment. Measurements, however, show that the depth of the cavity stagnates before bubble entrapment in a manner that is unseen in the simulation. This stagnation appears to be caused by a counterbalance between surface tension and buoyancy at the bottom of the cavity and to result in the entrapment and eventual detachment of this portion to form the bubble.

Sponsored by the Office of Naval Research.

Presented at the American Geophysical Union, November 19, 2002, San Francisco, CA.
Naval Research Laboratory Contribution Number NRL/AB/7440—02-1004.
Abstract
1 Page

(Elmore)

CAVITY AND FLOW MEASUREMENTS OF REPRODUCIBLE BUBBLE ENTRAINMENT FOLLOWING DROP IMPACTS

Elmore, P.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004
Chahine, G.
Dynaflow Inc.
Fulton, MD 20759
Oguz, H.
Johns Hopkins University
Baltimore, MD 21218

Abstract

High-speed motion pictures of air-water interface dynamics of drop impacts that reproducibly make bubbles are presented. The pictures show previously unobserved details of the phenomenon. Measurements are compared with available computational methods. Experimental and numerical results agree with each other on the overall shape of the interface and the occurrence of bubble detachment. Measurements, however, show that the cavity depth stagnates before bubble entrapment. This behavior is not predicted by simulation. Also discussed are the presence of a jet that strikes the new bubble after formation and the possible effect of droplet surface oscillations on bubble entrainment.

Sponsored by the Office of Naval Research.

Published in the *Journal of Experiments In Fluids,* October 2001.
Naval Research Laboratory Contribution Number NRL/JA/7440–01-1005.
Journal Article
10 Pages

(Elmore)

DISPERSION AND FREQUENCY DEPENDENT NONLINEARITY PARAMETERS IN A GRAPHITE-EPOXY COMPOSITE

Elmore, P.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004
Breazeale, M.
University of Mississippi
University, MS 38677

Abstract

Longitudinal phase velocity and nonlinearity parameter have been measured as a function of frequency in a laminate graphite-fiber-epoxy-resin composite. Domains are present in the sample. Amplitudes of both the fundamental and generated second harmonics were measured absolutely with a capacitive receiver. Phase velocity and nonlinearity parameter vary with frequency. The extent of the dispersion depends on the orientation of the domains. Comparison is made between the nonlinear differential equation appropriate for crystals and a new equation that accounts for frequency dependence. The newer equation describes the data more accurately than the crystalline model does, but appears to require additional terms. Since the composite can be highly attenuative and may have additional nonlinear terms that are not yet accounted for theoretically, a new description is needed for the nonlinear acoustics of a composite. Scattering is a likely cause of the frequency dependent behavior observed.

Sponsored by the Office of Naval Research.

Published in the *Journal of the Acoustical Society of America,* 2001.
Naval Research Laboratory Contribution Number NRL/JA/7440–01-1006.
Journal Article
31 Pages

(Flattem)

OBJECT DETECTION IN OCEANIC SEDIMENTS USING QUADRATIC DETECTORS AND WAVELETS

Flattem, E. Kalcic, M.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004
Martinez, A.
Tulane University
New Orleans, LA 70118

Abstract

Methods for processing parametric broadband sonar returns are presented with the goal of locating buried objects from clutter. A gain correction algorithm based on wavelets is employed to correct for frequency dependent signal losses in multiple frequency bands. Quadratic detectors are designed to filter in time, frequency, and spatial domains simultaneously. These normalized quadratic detectors are shown to successfully isolate regions with similar characteristics by exploiting spectral and temporal features in both the horizontal and vertical directions. Several examples are presented using data collected at field trials. One open field test was ran by Naval Research Laboratory (NRL) researchers in the Puget Sound. This data set is shown to contain many non-homogenous sediment and gas layers. Other data sets were collected by NRL researchers in an experimentally controlled, sand filled test bed located at the Lake Travis facility of the Applied Research Laboratory at the University of Texas at Austin. This data set portrays some of the difficulties with successfully identifying buried objects in sandy regions.

Sponsored by the Association of Diving Contractors International and the ROV Committee of the Marine Technology Society.

Published in the Underwater Intervention 2001 Conference, January 15-17, 2001.
Naval Research Laboratory Contribution Number NRL/PP/7440–00-1007.
Conference Proceedings on CD, M.1.2.
1-15 Pages.

(Gendron)

A CLIENT/SERVER BASED APPLICATION USING A C/JAVA INTERFACE

Gendron, M. Edwards, S. Myrick, S. Lohrenz, M. Trenchard, M.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

Since 1995, the Naval Research Laboratory (NRL) at the Stennis Space Center (NRLSSC) has been developing and enhancing a software application that allows naval AV-8B and F/A-18 aircraft mission planners and aircrew to design and build digital aeronautical chart coverages for cockpit moving-map displays. The application, known as the Moving-Map Composer (MMC), currently is implemented in the X-Windows graphical user interface (GUI) language and the C programming language.

Currently, MMC is only supported on Compaq Alpha computers running the OpenVMS operating system. This limitation requires end users to acquire Alpha stations, which are more expensive than standard Intel-based PC platforms. This paper will discuss reengineering methods being developed by NRLSSC to transform the existing MMC application to a Java and C-based program that will execute on many different hardware platforms and operating systems, including Linux, Windows NT and OpenVMS.

As part of this redesign, the new MMC will have the added capability to not only execute locally, but also reside on a centralized server. This Internet-based design will make MMC more accessible to a substantially greater number of users. To accomplish this, the new software architecture will be client/server based, with the server end implemented in Java. Existing C code will be linked into the Java server as a C library to maintain all current low-level MMC functionalities. Methods to easily extract C routines from the existing MMC software with minimal changes will be addressed, as well as portability issues such as file and path naming conventions, system specific calls, logicals, and compiler directives.

The client side of the new architecture can be implemented either as a Java GUI application, browser applet, or command line program that will run remotely on any desired workstation. The development of each client application will be discussed. A text-based query language will be developed to handle the communication between the server and client. This paper will provide a full description of this query language, as well as procedures for handling graphics file transportation, informational text, GUI controls and error messages within the query language.

Sponsored by the Naval Air Systems Command.

Presented at the Southern Conference on Computing, October 26-28, 2000, Hattiesburg, MS.
Naval Research Laboratory Contribution Number NRL/PP/7440—00-1009.
Conference Proceedings

(Gendron)

DEMONSTRATING A MOVING-MAP SYSTEM WITH ELECTRONIC CHARTS FOR IMPROVED LANE NAVIGATION: TESTING ON AAVs IN GULFPORT, MS

Gendron, M. Myrick, S. Edwards, S. Mang, R.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

Amphibious landing operations that are being conducted in a mined environment require the use of navigation lanes that have been cleared of mines. The amount of time required to clear mines is determined by the width of the lanes to be cleared where lane width is determined by the ability of the assault craft to successfully navigate within a cleared lane (i.e., its lane navigation capability). Therefore, vehicles with stronger navigation capabilities allow more narrow lanes to be cleared. This project is based on the premise that a moving map (MM) capability will facilitate more precise lane navigation, thereby reducing aggregate lane width requirements for mine clearance.

The Office of Naval Research (ONR) has funded the Naval Research Laboratory (NRL), Stennis Space Center, MS to equip amphibious assault vehicles with Differential GPS MM systems and electronic charting to test for improvements in lane navigation. These tests will be conducted on the Amphibious Assault Vehicle (AAV), the Landing Craft Utility (LCU), and the Landing Craft Air Cushion (LCAC). NRL will outfit each type of vehicle with the MM system and demonstrate its capabilities at Fleet Battle Experiment Juliet in July 2002 and Kernel Blitz 03 in FY-03Q2.

The NRL MM system is a relatively low cost commercial off-the-shelf (COTS) differential GPS (DGPS) moving-map navigation system that runs a government off-the-shelf (GOTS) moving-map software package figure 1). This system consists of a differential DGPS receiver and antenna capable of giving the vehicle's exact position within 5 meters. The DGPS is connected to a high performance, ruggedized, water-resistant Intel computer running the Portable Flight Planning System (PFPS) software suite that can display standard National Imagery and Mapping Agency (NIMA) navigational charts.

Sponsored by the Office of Naval Research.

Published as a Naval Research Laboratory Memorandum Report, September 30, 2002.
Naval Research Laboratory Contribution Number NRL/MR/7440—02-8280.
NRL Memorandum Report
12 Pages

(Gendron)

MOVING MAP COMPOSER

Gendron, M. Wischow, P. Trenchard, M. Lohrenz, M.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004
Riedlinger, L. Mehaffey, J.
Planning Systems Inc.
Slidell, LA 70458

Abstract

The Moving Map Composer (MMC) was developed to rapidly assemble digital aeronautical chart information for pilots flying missions on AV-8B and F/A-18 tactical aircraft equipped with digital moving map systems. The source information is a library of CD's with worldwide coverage at 6 different scales of interest. The challenge was to rapidly "cut and paste" seamless maps from hundreds of digital charts at the desired scale of interest for specific missions. Using COTS hardware, the data is then burned onto militarized Aircraft Optical Disks that the pilots actually fly with. MMC replaced proprietary PC-based systems, reduced processing times from 2 days to 1 hour, and added a user friendly graphical user interface.

Sponsored by NAVAIR.

Patented, April 17, 2001
Patent Number 6218965
Navy Case Number 76,358
NRL Patent

(Gendron)

THE DEVELOPMENT OF SOFTWARE TOOLS FOR SCANNING PAPER CHARTS INTO GEOTIFF IMAGE FILES

Gendron, M. Myrick, S. Trenchard, M.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

This paper presents the design and development of software tools that scans paper charts, converts the charts into digital raster images, geo-references the images, and outputs GeoTIFF-compliant image files. The GeoTIFF file format is an extension of the popular TIFF raster file format and defined by a tightly controlled specification. Sets of tags (i.e., information) are added to the TIFF file format and describe all cartographic information associated with the TIFF scanned map imagery. These tags describe such information as map projection, datum and geographic location. Many standard commercial and government applications, including moving-map programs, utilize GeoTIFF files. The Naval Research Laboratory at the Stennis Space Center (NRLSSC) has created a set of software tools in support of the Naval Air Systems Command Hornet and Harrier Programs (PMA-265 and PMA-257, respectively). NRLSSC scientists have written low-level C routines that geo-reference digital charts and convert them to GeoTIFFs. Graphical User Interfaces (GUIs) written in the X-Window System/Motif language were also developed for displaying charts during the scanning process and choosing geographic control points on a scanned image. Other GUIs designed allow the user to clip or remove undesirable areas on the charts and display the final registered raster images.

Sponsored by the Naval Air Systems Command.

Presented at the Mississippi Academy of Sciences Annual Meeting, February 21-22, 2002, Biloxi, MS.
Naval Research Laboratory Contribution Number NRL/AB/7440—01-1008.
Abstract
1 Page

(Gendron)

VECTOR MAP DATA COMPRESSION WITH WAVELETS

Ioup, J.
University of New Orleans
New Orleans, LA
Gendron, M. Lohrenz, M.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

Wavelets and wavelet transforms can be used for vector map data compression. The choice of wavelet, the level of decomposition, the method of thresholding, and the height of the threshold were investigated using the Wavelet Toolbox in MatLab. The Haar, Daubechies, symlet, biorthogonal, and Coiflet wavelets were evaluated for amount of compression and accuracy in reconstruction. The test vector map data set consisted of 1024 longitude and latitude points of coastline data. Wavelet packet compression threshold using a soft threshold was carried out for the longitude and latitude separately in a "transmitter" MatLab program. Reconstruction was performed in a different "receiver" MatLab program. The longitude and latitude were reconstructed separately from their wavelet packet coefficients. The resulting coordinates were used to plot the reconstruction map. The amount of compression was the percent of the wavelet coefficients that were set to zero, i.e., their absolute value fell below the threshold. The accuracy of the reconstruction was quantified by computing the root-mean-square error for each longitude and latitude value as compared to the original values. The average percent root-mean-square (rms) error, as well as the compression, was investigated as a function of threshold. For the test data set, compressions of around 50 percent were obtained with rms errors of less than one percent for wavelet packet decompositions using Haar, Daubechies, Coiflets, symlets, and biorthogonal wavelets. Reconstructed maps, compression and error percentages, and relative CPU times will be presented.

Sponsored by the Naval Research Laboratory.

Presented to the *Journal of Navigation*, September 2000.
Journal Article

(Gendron)

WAVELET DENOISING OF SIDESCAN SONAR IMAGES

Ioup, J. Ioup, G.
University of New Orleans
New Orleans, LA
Gendron, M. Bourgeois, B.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

One important application of wavelet transforms is for noise removal or denoising. The effectiveness of this technique is influenced by the choice of wavelet used, the decomposition level, and the threshold (both amplitude and type). Thirty different wavelets, several allowable decomposition levels, and a range of appropriate thresholds are tested. Preliminary results will be presented of wavelet denoising applied to two-dimensional acoustic backscatter imagery from a sidescan sonar in an attempt to better detect bottom features. Comparisons with Fourier based filtering are also discussed.

Sponsored by the Office of Naval Research.

Presented at the 142nd Meeting Of The Acoustical Society Of America, December 3-7, 2001, Fort Lauderdale, FL.
Naval Research Laboratory Contribution Number NRL/AB/7440–01-1002.
Abstract
1 Page

(Gendron)

WAVELET MULTI-SCALE EDGE DETECTION FOR EXTRACTION OF GEOGRAPHIC FEATURES TO IMPROVE VECTOR MAP DATABASES

Gendron, M.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004
Ioup, J.
University of New Orleans
New Orleans, LA

Abstract

Although numerous at smaller geographic scales, vector databases often do not exist at the more detailed, larger scales. A possible solution is the use of image processing techniques to detect edges in high-resolution satellite imagery. Features such as roads and airports are formed from the edges and matched up with similar features in existing low-resolution vector map databases. By replacing the old features with the new more accurate features, the resolution of the existing map database is improved. To accomplish this, a robust edge detection algorithm is needed that will perform well in noisy conditions. This paper will study and test one such method, the Wavelet Multiscale Edge Detector. The wavelet transform breaks down a signal into frequency bands at different levels. Noise present at lower scales smoothes out at higher levels. It is demonstrated that this property can be used to detect edges in noisy satellite imagery. Once edges are located, a new method will be proposed for storing these edges geographically so that features can be formed and paired with existing features in a vector map database.

Sponsored by the Naval Research Laboratory.

Published in the *Journal of Navigation,* January 2000.
Naval Research Laboratory Contribution Number NRL/PU/7440–00-0347.
Journal Article (Refereed)

(Gendron)

WAVELET MULTI-SCALE EDGE DETECTION USING AN ADALINE NEURAL NETWORK TO MATCH UP EDGE INDICATORS

Gendron, M.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004
Hammack, J.
Naval Oceanographic Office
Stennis Space Center, MS 39529

Abstract

The detection of sudden changes or discontinuities in data is an important issue in digital image processing. Such changes are often referred to as edge information or just edges. Finding edges are essential to many scientific areas ranging from computer vision to target detection. Not only must the detector be able to find the edges, but it must also be able to detect them in the presence of noise. Many edge-detecting algorithms perform well, but many times these algorithms break down in noisy conditions. One possible solution is to take advantage of the multiscale nature of the wavelet transform to detect edges in noisy conditions. This paper explores one possible method of extracting edge information in two-dimensional sidescan acoustic backscatter imagery using a Wavelet Multiscale Edge Detector (WMED). The WMED uses a wavelet transform to generate coefficients and break down a signal into frequency bands at different levels. Scaling a wavelet, or short waveform, with a scale factor and shifting its position produces these levels. Noise present at low levels is smoothed out and disappears at higher levels. The WMED examines and matches up large magnitude high frequency coefficients, called local maxima, over many different levels to detect edges. To enhance the ability of the detector to operate in very noisy conditions, the WMED is modified to use an ADALINE (ADAptive LInear NEuron) neural network that adapts to match up edge indicators across multiple wavelet levels. The ADALINE uses the least mean squared (LMS) learning rule to minimize the mean square error. The LMS algorithm is able to optimize the decision boundaries of the network. This makes the boundaries more effective in the presence of noise. This paper will test the capability of the ADALINE to match up the edge indicators in noisy two-dimensional sidescan imagery.

Sponsored by SPAWAR PMW 155.

Presented at the 2002 International Conference On Industry, Engineering, and Management Systems, March 11-13, 2002, Cocoa Beach, FL.
Naval Research Laboratory Contribution Number NRL/OP/7440—02-1005.
Oral Presentation
1 Page

(Gendron)

WAVELET MULTI-SCALE EDGE DETECTION USING AN ADALINE NEURAL NETWORK TO MATCH UP EDGE INDICATORS

Gendron, M.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004
Hammack, J.
Naval Oceanographic Office
Stennis Space Center, MS 39529

Abstract

The detection of sudden changes or discontinuities in data is an important issue in digital image processing. Such changes are often referred to as edge information or just edges. Finding edges are essential to many scientific areas ranging from computer vision to target detection. Not only must the detector be able to find the edges, but it must also be able to detect them in the presence of noise. Many edge-detecting algorithms perform well, but many times these algorithms break down in noisy conditions. One possible solution is to take advantage of the multiscale nature of the wavelet transform to detect edges in noisy conditions. This paper explores one possible method of extracting edge information in two-dimensional sidescan acoustic backscatter imagery using a Wavelet Multiscale Edge Detector (WMED). The WMED uses a wavelet transform to generate coefficients and break down a signal into frequency bands at different levels. Scaling a wavelet, or short waveform, with a scale factor and shifting its position produces these levels. Noise present at low levels is smoothed out and disappears at higher levels. The WMED examines and matches up large magnitude high frequency coefficients, called local maxima, over many different levels to detect edges. To enhance the ability of the detector to operate in very noisy conditions, the WMED is modified to use an ADALINE (ADAptive LInear NEuron) neural network that adapts to match up edge indicators across multiple wavelet levels. The ADALINE uses the least mean squared (LMS) learning rule to minimize the mean square error. The LMS algorithm is able to optimize the decision boundaries of the network. This makes the boundaries more effective in the presence of noise. This paper will test the capability of the ADALINE to match up the edge indicators in noisy two-dimensional sidescan imagery.

Sponsored by SPAWAR PMW 155.

Presented at the 2002 International Conference On Industry, Engineering, and Management Systems, March 11-13, 2002, Cocoa Beach, FL. Published on CD ISBN 0-9710330-1-3.
Naval Research Laboratory Contribution Number NRL/PP/7440—01-1016.
Conference Proceedings
6 Pages

(Harris)

ACQUIRING BATHYMETRY DATA WITH THE VSS SONAR ON THE AQS-20 MINE HUNTING SYSTEM

Harris, M. Avera, W. Gendron, M.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004
Seldenright, V.
Naval Surface Warfare Center
Coastal System Station, FL

Abstract

A goal of future naval development is to utilize fleet systems to acquire ocean environment measurements for tactical use 'on the spot'. A preliminary evaluation of data indicates that a future operational mine hunting system can provide needed bathymetry data in regions where adequate data does not exist. In this paper, bathymetric data is obtained from the Volume Search Sonar (VSS) on the Engineering Development Model (EDM) AN/AQS-20 Sonar, Mine Detecting Set to illustrate the capability. This system is a helicopter-towed mine hunting system with the capability to obtain coarse bathymetry data. The data are sufficient to meet the accuracy requirements for mine warfare operations.

Sponsored by The Oceanographer of the Navy via SPAWAR PMW155.

Presented at the Second Australian-American Joint Conference On The Technologies Of Mine Countermeasures, March 27-29, 2001, Sydney, Australia.
Naval Research Laboratory Contribution Number NRL/PP/7440—01-1002.
Conference Proceedings

(Harris)

ENVIRONMENTAL DATA ACQUISITION FROM THE AQS-20 MINE HUNTING SONAR REQUIREMENTS, TECHNICAL FEASIBILITY AND COST

Harris, M. Avera, W. Bibee, L.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

The Naval Research Laboratory (NRL) under the technical direction of SPAWAR PMW- 155 and the sponsorship of the Oceanographer of the Navy, N096, examined the requirements, technical feasibility and cost of extracting environmental data from the AQS-20 Mine Hunting Sonar towed from both the CH-60 helicopter and the AN/WLD-1 Remote Mine Hunting System. Information from the environmental data is to be used near real-time in tactical decision aids like the Mine Warfare Environmental Decision Aids Library (MEDAL). The requirements to collect environmental data have been established. The technical feasibility of extracting single beam bathymetry, multi-beam bathymetry, and sediment properties from the AQS-20 mission data tape has been demonstrated and documented based on experiments conducted in June 1998, July 1999 and June 2001. Cost estimates to implement the environmental data extraction have been generated working with the prime contractors for the AQS-20 and AN/WLD- 1(V) systems, Coastal Systems Station (CSS), the Naval Oceanographic Office and NRL.

Sponsored by the Oceanographer of the Navy via SPAWAR PMW 155.

Published as NRL/FR/7440—02-10002, May 15, 2002.
Formal Report
30 Pages

(Harris)

ENVIRONMENTAL DATA COLLECTION FROM THE AQS-20

Harris, M. Avera, W. Bibee, L.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004
Null, J. M.
Neptune Sciences Inc.
Corpus Christi, TX 78419

Abstract

The Naval Research Laboratory (NRL) under the technical direction of SPAWAR PMW-155 and the sponsorship of the Oceanographer of the Navy, N096, examined the technical feasibility of extracting environmental data from the AQS-20 Mine Hunting Sonar towed from both the MH-60 helicopter and the AN/WLD-1 Remote Mine Hunting System. Multibeam bathymetry and sediment information can be extracted from the AQS-20 and used in near real-time in tactical decision aids like the Mine Warfare Environmental Decision Aids Library (MEDAL). These conclusions are based on AQS-20 experiments conducted in June 1998, July 1999 and June 2001. This paper discusses the advantages of near real-time environmental data in MCM and describes a proposed Environmental Data Collection (EDC) Mode of operation for the AQS-20.

Sponsored by SPAWAR PMW 155.

Presented at the 5th International Symposium on Technology And The Mine Problem Conference, April 21-25, 2002.
Naval Research Laboratory Contribution Number NRL/PP/7440--02-1004.
Conference Proceedings
12 Pages

(Harris)

ENVIRONMENTAL DATA COLLECTION FROM THE AQS-20

Harris, M. Avera, W. Bibee, L.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004
Null, J. M.
Neptune Sciences Inc.
Corpus Christi, TX 78419

Abstract

The Naval Research Laboratory (NRL) under the technical direction of SPAWAR PMW-155 and the sponsorship of the Oceanographer of the Navy, N096, examined the technical feasibility of extracting environmental data from the AQS-20 Mine Hunting Sonar towed from both the MH-60 helicopter and the AN/WLD-1 Remote Mine Hunting System. Multibeam bathymetry and sediment information can be extracted from the AQS-20 and used in near real-time in tactical decision aids like the Mine Warfare Environmental Decision Aids Library (MEDAL). These conclusions are based on AQS-20 experiments conducted in June 1998, July 1999 and June 2001. This paper discusses the advantages of near real-time environmental data in MCM and describes a proposed Environmental Data Collection (EDC) Mode of operation for the AQS-20.

Sponsored by SPAWAR PMW 155.

Published in the *Journal of the Society for Counter-Ordnance Technology*, May 27, 2002.
Naval Research Laboratory Contribution Number NRL/JA/7440--02-1009.
Journal Article
12 Pages

(Harris)

MAPPING, CHARTING, AND GEODESY BRANCH
Abstracts of Publications, 1998 and 1999

Harris, M. James, D
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

This document presents abstracts of the 1998 and 1999 publications of the Mapping, Charting, and Geodesy Branch, Naval Research Laboratory, Stennis Space Center, MS 39529-5004.

Sponsored by the Naval Research Laboratory.

Published, June 2000.
Naval Research Laboratory Contribution Number NRL/PU/7440–00-419.
Special Report
76 Pages

(Harris)

TOW VEHICLE DEPTH VERIFICATION

Harris, M. Avera, W. Bibee, L.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

NRL demonstrated extraction of accurate single beam and multibeam bathymetry from a towed vehicle designed to locate mines in the water column. However, biases were encountered in measuring the static pressure depth of the moving vehicle. Water depth is calculated by simply adding tow vehicle depth, measured by a pressure sensor, to multibeam ranges to the seafloor, measured acoustically from the vehicle. Comparisons of the tow vehicle bathymetry with ground truth showed a shallow bias in depth. The pressure sensor was suspected based on previous experience measuring multibeam bathymetry on the unmanned semi submersible ORCA. There were two contributing sources of error. The first was pressure sensor calibration, the sensor needs to be "zeroed" before entering the water. The second and more interesting was that the sensor was measuring variations in pressure caused from vehicle velocity in addition to changes in vehicle depth. The challenge is measuring static depth from a moving vehicle. The acoustic signal from the first water surface bounce was used to measure the bias and correct for pressure sensor error. This paper describes the sensors, data and techniques used to compensate for the depth bias.

Sponsored by SPAWAR PMW 155.

Presented at the Oceans 2002 Conference and Exhibition, October 29-31, 2002, Biloxi, MS.
Naval Research Laboratory Contribution Number NRL/PP/7440--02-1008.
Conference Proceedings
4 Pages

(Harris)

VIDEO – PHASE I PROOF-OF-CONCEPT DEMONSTRATION FOR AN INTEGRATED CHARACTERIZATION OF THE LITTORAL ZONE

Harris, M. Holland, K. T. Shaw, K.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

The National Imagery and Mapping Agency, NIMA is investigating the potential of an interagency program to Characterize the Dynamic Littoral Zone for both civil and military applications. NIMA's mission is to provide timely, relevant, and accurate imagery, imagery intelligence, and geospatial information to national policy makers and military forces in support of national security objectives. Using the same types of data, civil authorities such as NOAA, USGS, FEMA, state and local government agencies serve the general public by providing up-to-date imagery, map, chart, and survey information in the dynamic littoral zone.

Coastal regions are rich in natural resources and as a result half of the world's population lives within 60 kilometers of a coastline. The land-water interface defining coastlines is constantly changing due to dynamic forces resulting from wind, wave and current processes. Environmental conditions in the littoral regions can have a serious impact in the civil sector and likewise can result in the success or failure of military operations.

Characterizing the vast littoral regions of the world is a formidable challenge. Scientific sensors and techniques to observe the dynamic processes occurring in coastal areas have been developed and fielded by independent federal and state agencies. These methods are typically used only for limited sections of a coast. Recently, a strong emphasis has been placed on collecting data over large regions using remote sensing. One additional advantage of remote sensing, for example using airborne photography, is that it allows cost effective temporal characterization of this dynamic nearshore region. Techniques to store and distribute littoral data via the Internet in near real-time are also needed. Scales of interest vary from fine scale turbulence disturbing grains of sand to large regional scales monitoring shoreline changes. A comprehensive, integrated and cost effective method of characterizing the littoral regions is needed that provides real-time in- situ and remotely sensed data via the Internet.

Sponsored by the National Imagery and Mapping Agency.

Published as a Naval Research Laboratory Oral Presentation, January 14, 2000.
Naval Research Laboratory Contribution Number NRL/OP/7440--00-0002.
Video

(Harris)

WEB PAGE - ADAPTIVE SENSORS AND SURVEY TECHNIQUES TEAM

Harris, M.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

The Adaptive Sensors team focuses on the development of advanced sensors and survey techniques in the collection of environmental data. Autonomous bathymetric survey techniques, demonstrated on NRL's unmanned ORCA vehicle, will provide survey ships the ability to survey an area in less time while meeting all coverage requirements with minimal human interaction. Airborne, waterborne and in-situ magnetic sensors are used to characterize the seafloor and water column. Techniques to determine wave parameters (height, length, period) and vessel dynamic draft from a moving vessel have also been developed. Another team focus is the acquisition of environmental data from minehunting sensors for on scene use in tactical decision aids and later database archival. Our newest thrust is the development of advanced navigation techniques intended to improve the precise positioning of tow vehicles and unmanned underwater vehicles (UUVs).

Sponsored by the Naval Research Laboratory.

Published as a Naval Research Laboratory Web Page, August 9, 2000.
Naval Research Laboratory Contribution Number NRL/OP/7440--00-0007.
http://postoffice.nrlssc.navy.mil/adaptivesensors/index.html
NRL Web Page

(Harris)

WEB PAGE - NRL MC&G BRANCH

Harris, M.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

As the Navy's Lead Lab in MC&G, continue supporting the R&D Vision/Needs and Plans of NIMA, ONR, CNO, Marine Corps Systems Commands and Nation. Direct link to team sites: Moving Map Composer Code 7440.1, Digital MC&G Analysis Program Code 7440.2, Nearshore Morphology Code 7440.3, Mapping Sciences Code 7440.4 and Adaptive Sensors Code 7440.5.

Sponsored by the Naval Research Laboratory.

Published as a Naval Research Laboratory Web Page, June 9, 2000.
Naval Research Laboratory Contribution Number NRL/OP/7440--00-0006.
http://postoffice.nrlssc.navy.mil/adaptivesensors/index.html
NRL Web Page

(Holland)

AN OPTIMAL APPROACH TO NEARSHORE BATHYMETRIC ESTIMATION

Holland, K. T. Plant, N.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004
Holman, R.
Oregon State University
Corvallis, OR 97331

Abstract

Although bathymetric surfaces in nearshore regions are typically complex and often dynamic, representative patterns of shape and behavior can be quantified. For example, the dominant temporal and spatial scales of bathymetric variability are commonly greater in the along-shore direction than in the cross-shore direction. Also, outside the inner surf zone, sand bars typically maintain an amplitude to wavelength ratio that is inversely proportional to their water depth. These and other deterministic properties of nearshore bathymetry have allowed the development of an optimal approach to nearshore bathymetric prediction for use in situations where in-situ sampling is either sub-optimal or impossible. One such situation is the use of remote sensing to provide frequent, but somewhat sparse and noisy estimates of bathymetry when compared to in-situ sampling. Our approach uses scale-controlled interpolation to estimate bathymetric surfaces under these conditions and to extend predictions into areas (or times) where only approximate knowledge, such as bar location but not depth, is known. The method is demonstrated using maximum likelihood representations of amplitudes, frequencies, and wavenumbers for nearshore morphodynamics obtained from long term measurements at Duck, NC USA. In summary, this approach provides an optimal estimate (with confidence intervals) of the bathymetry surface corresponding to minimal and/or noisy sampling. The extension of the method to predict temporal variations is also discussed.

Sponsored by the Office of Naval Research.

Presented at the American Geophysical Union, November 19, 2002, San Francisco, CA.
Naval Research Laboratory Contribution Number NRL/AB/7440—02-1001.
Abstract
1 Page

(Holland)

APPLICATION OF THE LINEAR DISPERSION RELATION WITH RESPECT TO DEPTH INVERSION USING REMOTELY SENSED IMAGERY

Holland, K. T.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

Remote sensing methods that utilize spatially distributed estimates of wave phase to determine water depth have been in practice for some time and are based upon the linear depth, dispersion equation for surface gravity waves. However, possible error sources resulting from the use of this dispersion relation under field conditions had yet to be rigorously quantified. This publication describes results of a dispersion relation validation effort using several hundred observations of wavenumber magnitude for sea-swell frequencies obtained over a wide variety conditions at a Duck, NC field site. These data were computed using sophisticated processing algorithms that yield precise wavenumber estimates and a strong attempt was made to correct for associated errors such as improper positioning, tidal variations, and Doppler shifts due to mean currents. These algorithms are essentially equivalent to similar methods that use estimates of wave phase as imaged through remote sensing. For water depths outside the surf zone region, the results indicate that the linear dispersion relation is highly accurate, with average estimation errors on the order of 3-9% of the observed depth. In shallower regions where wave breaking is evident and nonlinear effects are more pronounced, nominally less than 4 m Duck, normalized depth errors of over 50% were commonly observed. Correlations between magnitude of the errors and measured wave heights suggest the importance of wave amplitude in the calculation of shallow water phase speeds and correspondingly an empirical relation is described for correction of depth predictions based on application of the dispersion relation within the surf zone region.

Sponsored by the Office of Naval Research and the Naval Research Laboratory.

Published in the *IEEE Journal of Geoscience and Remote Sensing*, January 2001.
Naval Research Laboratory Contribution Number NRL/JA/7442—00-0017.
Journal Article

(Holland)

DIRECTIONAL CHARACTERISTICS OF COMPLEX SURF ZONES WAVES

Holland, K. T.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004
Dugan, J. Williams, J.
Arete Associates
Arlington, VA 22202

Abstract

Variation in wave direction prior to, during and subsequent to breaking is often substantial and can contribute significantly to surf zone circulation patterns. In addition to changes brought about by reflection and refraction, changes in directional spread may occur at the breakpoint due to processes unrelated to bathymetric variations. To accurately quantify breaker angle characteristics across a surf zone region, data adaptive methods for resolving directional wave spectra were applied to measurements collected during October and November 1999 at Duck NC. These measurements included in-situ "PUV" instrumentation along a cross-shore transect and high-resolution digital imagery of the surf zone region recorded from both fixed and airborne cameras. The use of multiple types of measurements allowed the computation of directional spectra at numerous locations over an approximately 300 m x 300 m region extending from outside the breakpoint to the shoreline. Directional broadening was observed to occur under moderate to high-energy wave conditions, which in some cases resulted in scattering patterns with multiple wave components propagating obliquely relative to the mean propagation direction. The most complicated wave patterns were generated just offshore of the shore-parallel sand bar that was also roughly coincident with temporally averaged breakpoint location. The characteristics of these waves and their possible generation mechanisms will be discussed.

Sponsored by the Office of Naval Research.

Presented at the AGU Meeting, December 10-14, 2001, San Francisco, CA.
Naval Research Laboratory Contribution Number NRL/AB/7440—01-1005.
Abstract
1 Page

(Holland)

HIGH-RESOLUTION, VIDEO BASED QUANTIFICATION OF SURF ZONE PROCESSES

Holland, K. T.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004
Williams, J. Piotrowski, C. Dugan, J.
Arete Associates
Crystal City, VA 22215

Abstract

For more than a decade, video image processing methods have been used to quantify nearshore processes. Examples include measurement of sandbar locations, beach slopes, swash processes, and alongshore currents. Until recently, the vast majority of these observations have been made from cameras mounted on fixed platforms such as towers, buildings, or hilltops and allowed long-term (multi-year) monitoring at a fairly rapid rate (up to 30 Hz, but typically only once per hour during daylight). Although this system, now in place at a number of world-wide locales (known as the ARGUS network), has been extremely successful, it suffers from two major disadvantages. First, the measurements are made using oblique imagery, which means that pixel resolution varies with distance from the camera location, and secondly, the systems are not easily relocatable. A new system has been developed, known as AROSS for Airborne Remote Optical Spotlight System, which allows 12-bit, 1-rn resolution, geo-rectified imagery to be collected from an airborne vehicle.

AROSS data was sampled at Duck, NC over a three-week period during the SHOaling Wave Experiment (SHOWEX) in 1999. This AROSS imagery was analyzed and compared to simultaneously sampled ARGUS imagery. Comparisons between the two methods and in relation to in-situ groundtruth for bathymetry, the location of morphological features, wave conditions and currents were made. Generally, the estimates from both systems showed excellent agreement, but in some cases the AROSS system had a slightly higher accuracy relative to measurements from the fixed instrumentation. Given the large spatial extent and sampling density of the AROSS imagery (nominally 2 km x 2 km at a 1 m spacing), a number of advanced array processing applications are possible, including 3D frequency-wavenumber spectra, at a resolution that exceeds traditional sampling methods. Examples of the directional distribution of energy in 8-m depth are shown. In summary, AROSS promises to become an important tool in the collection of nearshore data.

Sponsored by the Office of Naval Research.

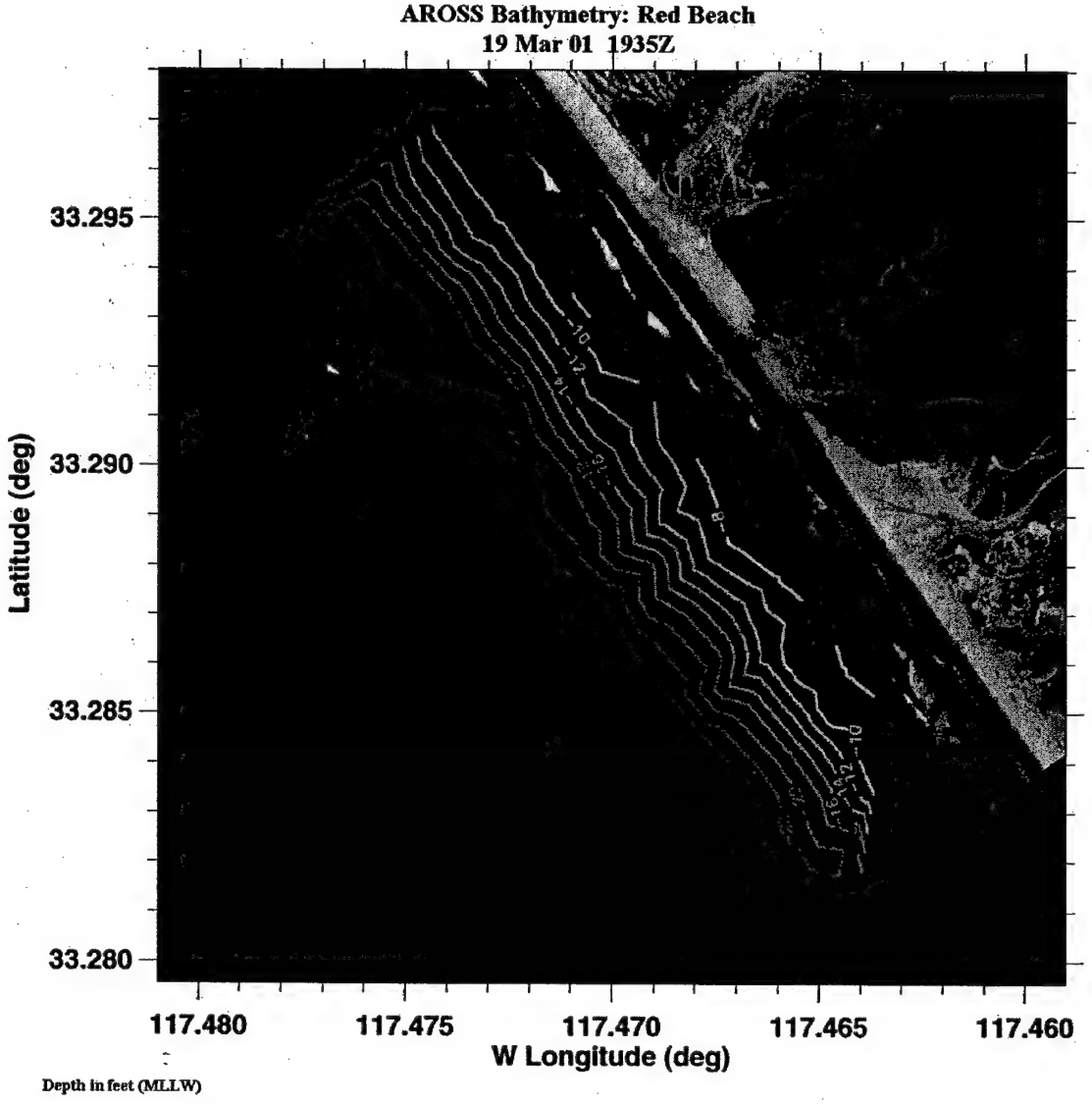
Published at the AGU Fall Meeting, December 2000, San Francisco, CA.
Naval Research Laboratory Contribution Number NRL/AB/7440—00-0017.
Abstract

(Holland)

KB01 RED BEACH BATHYMETRY

Holland, K. T.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract



Sponsored by the Office of Naval Research.

Presented to NAVO WSC, March 26, 2001.
Naval Research Laboratory Contribution Number NRL/OP/7440—00-1004.
Oral Proceedings (Image)

(Holland)

LITTORAL ENVIRONMENTAL NOWCASTING SYSTEM (LENS)

Holland, K. T. Puleo, J. Plant, N. Kaihatu, J.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

Recent advances in electro-optical imaging sensors, environmental characterization algorithms and nearshore circulation models will soon allow near-real-time, high-resolution characterization of littoral regions using unmanned aerial vehicles (UAVs). The fundamental objective of a new program at the Naval Research Laboratory is to develop a UAV-based system that couples remotely acquired imagery with advanced data analysis and state-of-the-art numerical models to provide a nowcast of littoral environmental conditions. The conceptual use of this system includes the estimation of waves, currents, and bathymetry to support MCM operations particularly with respect to very shallow water and surf zone regions. The system is envisioned to operate organically in that no external sources of information are required. The framework of this system is described and the issues pertaining to operational deployment are discussed.

Sponsored by the Office of Naval Research.

Presented at the Oceans 2002 Conference and Exhibition, October 29-31, 2002, Biloxi, MS.
Naval Research Laboratory Contribution Number NRL/PP/7440--02-1023.
Conference Proceedings
Pages 1234-1239

(Holland)

MEASUREMENT OF PHYSICAL MODEL WAVE DIFFRACTION PATTERNS USING VIDEO

Curtis, W. Seabergh, W.
US Army Engineer Research and Development Center
Vicksburg, MS 39180
Hathaway, K.
US Army Engineer Research and Development Center
Kitty Hawk, NC 27949
Holland, K. T.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

The complex interaction of surface waves with coastal inlet structures and inlet morphology is of significant importance to navigation channel operation and maintenance. Wave data in the vicinity of coastal inlets are limited. Where field wave data exist, the temporal and spatial coverage is inadequate to resolve the evolution of wave refraction and diffraction patterns of the free surface. To address the challenge of quantifying variations in wave direction in the coastal system, the US Army Engineer Research and Development Center applied video techniques in a physical model to obtain spatially and temporally dense measurements of wave direction. These measures are required to advance understanding of first-order inlet processes and to use the measurements in numerical simulation model development and verification. In this paper, detailed results are discussed for random and a single monochromatic wave experiments conducted for evaluation of wave diffraction patterns influenced by coastal structures and coastal inlet bathymetry.

Sponsored by the Office of Naval Research.

Presented at the 4th International Symposium On Ocean Wave Measurement and Analysis, September 3-5, 2001, San Francisco, CA.
Naval Research Laboratory Contribution Number NRL/PP/7440—00-1005.
Conference Proceedings

(Holland)

MODELING SMALL-SCALE NEARSHORE PROCESSES

Slinn, D. Hanes, D.
University of Florida
Gainesville, FL 32611-6590
Holland, K. T. Puleo, J.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

In recent years advances in high performance computing have made it possible to gain new qualitative and quantitative insights into the behavior and effects of coastal processes using high-resolution physical-mathematical models. The Coastal Dynamics program at the U.S. Office of Naval Research under the guidance of Dr. Thomas Kinder has encouraged collaboration between modelers, theoreticians, and field and laboratory experimentalists and supported innovative modeling efforts to examine a wide range of nearshore processes. An area of emphasis has been small-scale, time-dependent, turbulent flows, such as the wave bottom boundary layer, breaking surface waves, and the swash zone and their effects on shoaling waves, mean currents, and sediment transport that integrate to impact the long-term and large-scale response of the beach system to changing environmental conditions. Examples of small-scale modeling studies supported by CD-321 related to our work include simulation of the wave bottom boundary layer. Under mild wave field conditions the seabed forms sand ripples and simulations demonstrate that the ripples cause increases in the bed friction, the kinetic energy dissipation rates, the boundary layer thickness, and turbulence in the water column. Under energetic wave field conditions the ripples are sheared smooth and sheet flow conditions can predominate, causing the top few layers of sand grains to move as a fluidized bed, making large aggregate contributions to sediment transport. Complementary models of aspects of these processes have been developed simultaneously in various directions (e.g., Jenkins and Hanes, JFM 1998; Drake and Calantoni, 2001; Trowbridge and Madsen, JGR, 1984). Insight into near-bed fluid-sediment interactions has also been advanced using Navier-Stokes based models of swash events. Our recent laboratory experiments at the Waterways Experiment Station demonstrate that volume-of-fluid models can predict salient features of swash uprush-backwash interactions under controlled conditions. While much has been achieved towards understanding the intricacies of these natural systems using nonlinear models, many questions remain to challenge future engineers and scientists. During his tenure at ONR, Tom Kinder has championed the importance of nearshore science and increased resources within the area, made accomplishments visible to the broader ocean community, increased communication between researchers through comprehensive initiatives, field experiments and workshops, helped develop 10 year plans focusing future priorities, maintained a stable environment for researchers, and encouraged them to tackle the hardest (most interesting) problems and to develop new tools along the way with which to solve them.

DE: 1724 Ocean sciences
DE: 4512 Currents
DE: 4558 Sediment transport
DE: 4564 Tsunamis and storm surges
DE: 4568 Turbulence, diffusion, and mixing processes
SC: OS

Sponsored by the Office of Naval Research.

Presented at the American Geophysical Union 2001 Fall Meeting, December 10-14, 2001, San Francisco, CA.
Naval Research Laboratory Contribution Number NRL/AB/7440—01-1009.
Abstract 1 Page

(Holland)

OVERVIEW OF LITTORAL DYNAMICS RESEARCH

Holland, K. T.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

The dynamic nature of the littoral region requires rapid assessment of environmental information to anticipate the impact of coastal dynamics on systems and operations. New models, observing systems and through-the-sensor technologies are being developed to help solve this significant naval problem. This talk describes the present state of the art in US basic and applied research concerning littoral dynamics with an emphasis on future directions. A major thrust of these efforts will be the evolution of a monitoring system coupled to numerical models to enable high resolution environmental nowcasts of the littoral region.

Sponsored by the Office of Naval Research.

Presented at the SACLANTCEN 2002 Conference, May 16, 2002, La Spezia, Italy.
Naval Research Laboratory Contribution Number NRL/OP/7440—02-1008.
Oral Presentation
1 Page

(Holland)

QUANTIFICATION OF SWASH FLOWS USING VIDEO-BASED PARTICLE IMAGE VELOCIMETRY

Holland, K. T. Puleo, J. Kooney, T.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

Understanding of fluid flows and sediment transport in the swash region has been severely hampered by the difficulty of obtaining swash flow velocity measurements in the dynamic and extremely shallow foreshore region. We present a digital imaging method, known as particle image velocimetry, to quantify the horizontal flow structure of swash. This technique exploits similar patterns of image intensity in multiple images sampled sequentially to identify spatial offsets corresponding with maximum correlations between image subregions. These offsets are used in conjunction with the sampling interval to derive velocity vectors describing the horizontal flow structure. Pre-processing methods to georectify oblique imagery to a planar surface and post-processing methods of correcting spurious vectors are described. The PIV method overcomes many of the limitations of in-situ sampling of swash and is shown consistent with results from a previously tested remote sensing technique for measuring swash edge velocities. In general, this technique provides a unique capability for spatially extensive and well-resolved quantification of swash flows.

Sponsored by the Office of Naval Research.

Published in the *Coastal Engineering,* January 2001.
Naval Research Laboratory Contribution Number NRL/JA/7440–00-0026.
Journal Article (Refereed)

(Holland)

SPACE-TIME IMAGING OF SHOALING WAVES AND SURF

Dugan, J. Piotrowski, C. Williams, J.
Areté Associates
Crystal City, VA 22202
Holland, K. T.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

A fundamental barrier to consequential evaluation of modem, very capable shoaling wave and surf models has been the inability to provide high-quality ocean data with which to test model results. This paper describes a development intended to satisfy this need by providing space-time visible images of the nearshore from which three parameters crucial to such evaluations are simultaneously retrieved. These fields are the wave spectrum, bathymetry and currents. A panchromatic digital framing camera has been mounted on a small aircraft and used to collect time series of images of waves as they shoal and break. The camera system is controlled by a computer-driven turret which provides accurate location and pointing angles so that the images can be mapped to the mean water level on a common geodetic reference surface. This effectively separates space and time variations associated with the waves. The resulting time series imagery can be mapped and displayed much like a *movie* taken from a sky hook. These data are used with algorithms to retrieve the ocean parameters of interest, specifically the wave spectrum, water depth and currents. The 3-D frequency-wavenumber spectrum is calculated in sub-regions of the nominal 2 km scene, and the theoretical dispersion relation for linear gravity waves is fit to the spectrum, with the local water depth and current as free parameters. Also, the frequency-direction (f-d) spectrum is computed by integrating the 3-D spectrum. Comparisons of these results are made with a bathymetry survey, ADCPs, and the spectrum from the pressure array at the USACE FRF as part of the SHOaling Wave EXperiment (SHOWEX). The retrieved f-d spectrum is essentially identical to the FRF spectrum, except in instances when alongshore currents Doppler shift the higher frequency waves. Also, the retrieved water depths and currents generally are accurate to 5% relative values. In addition, the patterns of wave breaking also are analyzed to infer the patterns of wave stress and the morphology in the surf zone, much as has been done with visible image data from the ARGUS tower-mounted video cameras in recent years.

Finally, these parameters can be retrieved across much of the 2 km imagery, so that these product fields can be compared directly with the output fields of 2-D shoaling wave and surf models. Since these are the same parameters that are essential elements of various nearshore models, we suggest that a unique use of these data sets is providing test cases for evaluating shoaling wave and surf models. Data sets were collected both at FRF and nearby Oregon Inlet during SHOWEX, so test cases could be assembled for both simple and complex morphology.

Sponsored by the Office of Naval Research.

Presented at the 4th International Symposium On Ocean Wave Measurement and Analysis, September 3-5, 2001, San Francisco, CA.
Naval Research Laboratory Contribution Number NRL/PP/7440—00-1006.
Conference Proceedings

(Holland)

THE CORPS OF ENGINEERS' FIELD RESEARCH FACILITY: MORE THAN TWO DECADES OF COASTAL RESEARCH

Birkemeier, W.
U.S. Army Corps of Engineers
Kitty Hawk, NC 27949
Holland, K. T.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

The Field Research Facility (FRF), located on the Atlantic Ocean in Duck, North Carolina was established by the U.S. Army Corps of Engineers in 1977 to support the Corps' coastal engineering research requirements. The facility consists of a 560-m (1840-ft) long research pier, a main office building, field support building, and a 40 m (130-ft) observation tower. Since its creation, the FRF has maintained a comprehensive, long-term monitoring program of the coastal ocean including waves, tides, currents, local meteorology, and the concomitant beach response. This monitoring program is supported by a small, highly skilled field staff and several unique vehicles that permit successful operations in the turbulent surf zone. These capabilities have also supported a series of multi-agency multi-investigator experiments that have led to the Duck beach becoming the most studied beaches in the world. To date, approximately 150 journal articles, 108 reports, 84 conference proceedings papers, and more than 100 presentations have been published or given using FRF data by more than 200 authors. This paper summarizes the capabilities of the FRF and reviews the impact of its first 23 years of operation.

Sponsored by the U.S. Army Corps of Engineers and the Office of Naval Research.

Published in the *Shore and Beach,* March 2001, Volume 69(1): Pages 3-12.
Naval Research Laboratory Contribution Number NRL/JA/7440–01-1001.
Journal Article (Refereed)

(Holland)

VARIABLE SWASH MOTIONS ASSOCIATED WITH FORESHORE PROFILE CHANGE

Holland, K. T. Puleo, J.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

Variations in swash motions over a temporally changing foreshore surface are examined over the first tidal cycle following the onset of a storm using high-resolution video observations obtained at Duck, NC. A dramatic example of profile adjustment was observed where nearly one m of vertical change occurred over a four-hour time period. Swash edge excursion measurements during this study compare favorably with predictions from standard equations describing ballistic motions of an object on a plane slope under quadratic friction. Although this type of modeling has been previously used to describe shoreline motions following bore collapse, these unique observations of beach profile adjustment show a somewhat surprising tendency towards a predictable equilibrium between swash motions and profile response. The stability condition relates beach slope to incident wave period and initial uprush velocity such that the beach adjusts to minimize the difference between swash duration and incident wave period. Based on this finding, a simple morphodynamic model for changes in beach slope gradient as a function of swash and surf conditions is presented and shows close agreement with the field data.

Sponsored by the Office of Naval Research.

Published in the *Journal of Geophysical Research* 106 (C3): Pages 4613-4623, March 15, 2001.
Naval Research Laboratory Contribution Number NRL/JA/7442–99-0019.
Journal Article (Refereed)

(Holland)

VIDEO-BASED SENSING OF SURF ZONE ENVIRONMENTAL PROCESSES

Holland, K. T. Puleo, J. Kooney, T.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004
Holman, R. Stanley, J.
Oregon State University
Corvallis, OR 97331

Abstract

With the increasing naval interest in very shallow water and surf zone regions comes the inherent difficulty of acquiring relevant environmental assessments of this highly dynamic nearshore area. Given the large spatial gradients and rapid changes in surf zone processes, remote sensing is an obvious solution. However, traditional approaches, such as satellite remote sensing, are often limited with respect to resolution, temporal coverage, and/or expense. In contrast, automated, video-based techniques have been developed for fixed platforms that allow economical long-term sampling of various parameters including wave conditions, current strengths, and even depth profiles. The generalized approach is described in Holland et. al., IEEE Journal of Oceanic Engineering (1997).

A network of video stations has been in development for over a decade to provide observations of surf zone morphology (shoreline, sand bars, and other beach features), presently at over a dozen sites worldwide. These stations have been used largely to support academic research of nearshore morphodynamic processes, but a recently installed station at Assault Craft Unit Five, Camp Pendleton. CA has been extended to allow hourly (daylight) measuring of nearshore oceanographic conditions, as well. This combination of monitoring the hydrodynamics (including wave period, incidence angle. surf zone width, and inferred breaker height) and the morphodynamics (including shoreline location and offshore bar location) allows a more complete historical characterization and a more accurate nowcast of environmental conditions than is possible using sparse temporal sampling. The data are provided to the defense community in support of amphibious operations at Camp Pendleton via a web-based interface.

This paper describes the station location, the data collection methodology involved and the analysis procedures required to provide automated environmental characterization in support of Naval operations. Comparisons with groundtruth measurements are also presented to establish the accuracies and limitations of the various estimates. We also discuss how these techniques are being adapted for military use such as to allow sampling from moving platforms including Unmanned Aerial Vehicles (UAVs). In general, this low cost, flexible approach using video-based sensing has the potential to provide information concerning a number of scientifically and militarily relevant nearshore parameters with minimal logistical difficulty.

Sponsored by the Office of Naval Research and the Naval Sea Systems Command.

Presented at the Oceanic Imaging Conference 2000, May 2-5, 2000, Newport, RI.
Naval Research Laboratory Contribution Number NRL/PP/7442--00-0003.
Conference Proceedings

(Holland)

WEB PAGES – NEARSHORE MORPHOLOGY TEAM

Holland, K. T.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

NRL's Foreshore Sediment Transport (NRL 7440.3) team addresses basic research problems in understanding and predicting interactions between swash fluid motions and the underlying mobile sediments. This project is an ongoing study to discriminate between important processes to sediment transport on the foreshore (swash zone) such as bore turbulence, friction, percolation, swash asymmetry, rapid velocities and accelerations. Further, existing models of sediment transport are tested and new models for sediment transport and beach equilibrium and developed and tested. This area of research has important civilian and military application. Specifically, processes occurring on the foreshore determine the erosion/accretion patterns of the beach, which have important ramifications for loss of property, but more important for the Navy, yield critical information on beach conditions for landings and military exercises.

This project hinges on the use of video imagery obtained from fixed cameras (but has the potential to be utilized from aerial vehicles). Links to descriptions and applications of this technology below.

- Types of video imagery collected and Quantitative Information From Video Imagery
- Link to basic research uses (ARGUS)
- Link to military uses(VISSER)

Sponsored by Naval Research Laboratory.

Published as a Naval Research Laboratory Web Page, January 21, 2000.
Naval Research Laboratory Contribution Number NRL/OP/7442–00-0003.
NRL Web Page

(Kalcic)

FINAL REPORT FOR THE TRIFOCAL SENSOR TECHNOLOGY DEVELOPMENT PROJECT

Lambert, D. Kalcic, M.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004
Griffin, S.
Omni Technologies, Inc.
New Orleans, LA
Rayner, L.
Naval Sea Systems Command
Crystal City, VA
Benjamin, K.
Naval Sea Systems Command
Newport, RI
Sample, D.
SPAWAR Systems Center
San Diego, CA

Abstract

The Tri-Parametric Focusing and Locating (TRIFOCAL) target detection algorithms were developed. The TRIFOCAL target detection algorithms were developed with the following objectives: 1) improve the signal to reverberation and noise ratio for buried targets; 2) develop target enhancement and detection algorithms; 3) classify target characteristics; and 4) develop real-time software implementations of these algorithms.

The TRIFOCAL target detection process is based on three transducers detecting the same linear object, or triple detection. To this effect, many approaches were used to enhance the target and suppress background interference such that the three sensors would *simultaneously* detect the target, while random effects were *only* detected by one of the sensors. The report presents the signal and reverberation issues with emphasis on the target, signal and sediment characteristics. Target detection approaches follow from these characteristics, which are non-stationary, using time-frequency techniques. Results are based on the use of only one sensor, and must be extended for use with three sensors.

Sponsored by NAVSEA.

Published as a Naval Research Laboratory Memorandum Report, July 31, 2001.
Naval Research Laboratory Contribution Number NRL/MR/7431—01-8259.
NRL Memorandum Report

(Ladner)

A DATA STRUCTURE FOR 3D SYNTHETIC ENVIRONMENT RECONSTRUCTION

Ladner, R.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004
Abdelguerfi, M.
University of New Orleans
Wilson, R. McCreedy, F. Breckenridge, J. Shaw, K.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

The Digital Mapping, Charting and Geodesy Analysis Program (DMAP) at the Naval Research Laboratory has investigated an extension to the National Imagery and Mapping Agency's (NIMA's) current Vector Product Format (VPF) known as VPF+. This paper describes VPF-l- and a prototyped 3D synthetic environment using VPF+. The latter was designed as a 3D Geographic Information System (3D-GIS) that would assist the U.S. Marine Corps with mission preparation and also provide onsite awareness in urban areas. The prototype supplements the more traditional 2D digital-mapping output with a 3D interactive synthetic environment.

Sponsored by the National Imagery and Mapping Agency and the U. S. Marine Corps Warfighting Lab.

Presented at the International Conference on Augmented, Virtual Environments and 3-D Imaging, May 30 – June 1, 2001, Mykonos, Greece.
Naval Research Laboratory Contribution Number NRL/PP/7440–01-1005.
Conference Proceedings

(Ladner)

A DISTRIBUTED VIRTUAL REALITY PROTOTYPE FOR REAL TIME GPS DATA

Ladner, R.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004
Abdelguerfi, M. Klos, L.
Richard III, G. G. Liu, B.
University of New Orleans
Shaw, K.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

We describe a prototype that provides distributed, three-dimensional, interactive virtual worlds, which are enhanced with reliable communication and recording of real time events throughout the system. These events correspond to personnel movements in the real world, which are captured from GPS transmissions and are reflected by the movement of 3D human figures within the corresponding synthetic environment in real time.

Sponsored by the National Imagery and Mapping Agency, the U. S. Marine Corps Warfighting Lab and the Louisiana Board of Regents Support Fund.

Presented at the 2nd International Symposium on Telegeoprocessing, May 10-12, 2000, Nice, France.
Naval Research Laboratory Contribution Number NRL/PP/7441–00-0006.
Conference Proceedings

(Ladner)

A FRAMEWORK FOR DATABASING 3D SYNTHETIC ENVIRONMENT DATA

Ladner, R.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004
Abdelguerfi, M.
University of New Orleans
Wilson, R. Breckenridge, J. McCreedy, F. Shaw, K.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

Since 1994 the Digital Mapping, Charting and Geodesy Analysis Program at the Naval Research Laboratory has been developing an object-oriented spatial and temporal database, the Geographic Information Database (GIDB™). Recently, we have expanded our research in the spatial database area to include three-dimensional synthetic environment (3D SE) data. This work has focused on investigating an extension to the National Imagery and Mapping Agency's (NIMA's) current Vector Product Format (VPF) known as VPF+. This paper overviews the GIDB and describes the data structures of VPF+ and a prototyped 3D synthetic environment using VPF +. The latter was designed as a 3D Geographic Information System (3D-GIS) that would assist the U.S. Marine Corps with mission preparation and also provide onsite awareness in urban areas.

Sponsored by the National Imagery and Mapping Agency and the U. S. Marine Corps Warfighting Lab.

Presented at the 12th International Conference on Database And Expert Systems Applications, September 3-7, 2001, Munich, Germany.
Naval Research Laboratory Contribution Number NRL/PP/7440–01-1004.
Conference Proceedings

(Ladner)

AN OVERVIEW OF 3D SYNTHETIC ENVIRONMENT CONSTRUCTION

Ladner, R. Shaw, K.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

This chapter provides introductory material on three-dimensional synthetic environments. Readers are given an understanding of what synthetic environments are and how they are used in varied disciplines along with a look at some of the technologies used for synthetic environment visualization. Readers are provided with an outline of the sources and nature of synthetic environment data and are presented with the challenges associated with constructing realistic synthetic environments.

Sponsored by the National Imagery and Mapping Agency and the U.S. Marine Corps Warfighting Lab.

Published in the 3-D Synthetic Environment Reconstruction From Start To Finish, Kluwer Publication Book, 2001.
Naval Research Laboratory Contribution Number NRL/BA/7440--00-1001.
Book Chapter 1, Pages 11-34.

(Ladner)

ASSESSMENT OF SPATIAL DATA MINING TOOLS FOR INTEGRATION INTO AN OBJECT-ORIENTED GIS (GIDB)

Ladner, R. Petry, F.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

A variety of data mining techniques are under evaluation on the spatial data of concern in our setting. We are planning to integrate a number of these techniques into our geospatial system (GIDB). Three approaches are under special consideration and are described in the paper. A COTS data mining system has been successfully used to develop predictive models of near-shore conditions such as wave height for naval amphibious operations. Attribute generalization was applied to seafloor data to obtain statements about conditions relevant to mine warfare. Finally an extension of association rule discovery applied to fuzzy spatial data that is under development is discussed.

Sponsored by the Office of Naval Research.

Presented at the DEXA 2002 Conference, September 2-6, 2002, Aix-en-Provence, France.
Naval Research Laboratory Contribution Number NRL/PP/7440--02-1004.
Conference Proceedings (Refereed)
10 Pages

(Ladner)

3D MAPPING OF AN INTERACTIVE SYNTHETIC ENVIRONMENT

Ladner, R. Shaw, K.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004
Abdelguerfi, M.
University of New Orleans

Abstract

Traditional geospatial information systems (GIS) use geographically referenced data to produce highly accurate digital maps. These two-dimensional maps include well-recognized symbols that represent features such as mountains, forests, buildings, and transportation networks. Although this flat view provides an excellent means of orienting the user to the general nature and location of the geographic features for a given area, it does not provide the full experiential value that comes from immersion within a 3D environment.

To address this inherent shortcoming, the Naval Research Laboratory's Digital Mapping, Charting, and Geodesy Analysis Program (DMAP) has worked in conjunction with the University of New Orleans' Computer Science Department to develop a 3D-GIS. Specifically, we sought to develop a GIS that would assist the US Marine Corps with mission preparation and rehearsal and also provide onsite awareness during actual field operations in urban areas. Because these operations require practice in physically entering and searching both entire towns and individual buildings, we designed a 3D-GIS that supplements the more traditional 2D digital-mapping output with a 3D interactive synthetic environment.

We designed the 3D output to go beyond presenting stereoscopic views of an area or merely applying phototextures to highly simplified geometric shapes. Instead, we created an environment that replicates its real-world counterpart by including detailed 3D objects. We included natural features as well as manmade structures such as buildings, roads, and streetlights. We maximized the user's experience within this synthetic environment by providing for movement and interaction consistent with the types of interactions expected of Marines during anticipated operations. Specifically, we constructed the environment so that users can walk or fly across terrain, and they can enter buildings through doorways or climb in through open windows. We constructed synthetic buildings that conform to their real-world floor plans, allowing direct line of sight into and out buildings through open doorways and windows. Additionally, once inside a building, users can enter doorways to walk through interior rooms or climb stairs to access different floors.

Sponsored by the National Imagery and Mapping Agency and the U. S. Marine Corps Warfighting Lab.

Published in the *IEEE Computer*, March 2000.
Journal Article

(Ladner)

KNOWLEDGE DISCOVERY IN OCEANOGRAPHIC DATABASES: ISSUES OF COMPLICATIONS IN DATA SOURCES

Ladner, R. Petry, F.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

Data mining or knowledge discovery refers to a variety of techniques having the intent of uncovering useful patterns and associations from large databases. We have been working with data mining techniques for a variety of oceanographic data and have encountered a number of troublesome issues relative to available data. We describe the steps preparatory to data mining and three data mining techniques that we have applied to spatio-temporal data. We include a detailed review of various sources of geospatial, oceanographic and meteorological data and associated issues inherent in their use in knowledge discovery. We also provide issues relevant to the difficulties in providing an overall integration of this heterogeneous data for knowledge discovery.

Sponsored by the Office of Naval Research.

Presented at the Oceans 2002 Conference and Exhibition, October 29-31, 2002, Biloxi, MS.
Naval Research Laboratory Contribution Number NRL/PP/7440--02-1026.
Conference Proceedings (Refereed)
7 Pages

(Ladner)

MINING SPATIO-TEMPORAL INFORMATION SYSTEMS

Ladner, R. Shaw, K.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004
Abdelguerfi, M.
University of New Orleans
New Orleans, LA

Abstract

We are facing a rapidly growing capability to collect more and more data regarding our environment. With that, we must have the ability to extract more insightful knowledge about the environmental processes at work on the earth. Spatio-Temporal Information Systems (STIS) will especially prove beneficial in producing useful knowledge about changes in our world from these ever burgeoning collections of environmental data.

STIS provide the ability to store, analyze and represent the dynamic properties of the environment, that is, geographic information in space and time. An STIS, for example, can produce a weather map, but more importantly, it can present a user with information in map or report form indicating how precipitation progresses in space over time to affect a watershed. Other uses include forestry and even electrical systems management. Forestry experts using an STIS are able to examine the rates of movements of forest fires, how they evolve over time, and their impact on forest growth over long periods of time. A large electrical network system manager uses an STIS to track the failures and repairs of electrical transformers. Use of an STIS in this case allows the reconstruction of the status of the network at any given past time.

Mining Spatio-Temporal Information Systems, an edited volume will be composed of chapters from leading experts in the field of Spatial-Temporal Information Systems and will address the many issues in support of modeling, creation, querying, visualizing and mining. This book is intended to bring together a coherent body of recent knowledge relating to STIS data modeling, design, implementation and STIS in knowledge discovery. In particular, the reader will be exposed to the latest techniques for the practical design of STIS, essential for complex query processing.

Mining Spatio-Temporal Information Systems is structured to meet the needs of practitioners and researchers in industry and graduate-level students in Computer Science.

Sponsored by the Office of Naval Research.

Published in the Mining Spatio-Temporal Information Systems Book, August 2002.
Naval Research Laboratory Contribution Number NRL/BO/7440—02-1001.
Book, Pages 1-168.

(Ladner)

SPATIO-TEMPORAL DATA MINING AND KNOWLEDGE DISCOVERY: ISSUES OVERVIEW

Ladner, R. Petry, F.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

Data mining or knowledge discovery refers to a variety of techniques having the intent of uncovering useful patterns and associations from large databases. The initial steps of data mining are concerned with preparation of data, including data cleaning intended to resolve errors and missing data and integration of data from multiple heterogeneous sources. Next are the steps needed to prepare for actual data mining including the selection of the specific data relevant to the task and the transformation of this data into a format required by the data mining approach. Finally specific data mining algorithms such as class description, association rules and classification clustering are applied. There are specific characteristics of spatial and temporal data, as found in GIS and multi-media data, that make knowledge discovery in this domain more complex than in mining ordinary data such as found in typical business sales applications. Here we provide a survey of work in spatio-temporal data mining emphasizing the special characteristics. An overview is given of different sources and types of geospatial, oceanographic and meteorological data and the associated issues inherent in their use in knowledge discovery.

Key words: Data Mining, Spatio-temporal Data, Data Preparation

Sponsored by the Office of Naval Research.

Published in the Mining Spatio-Temporal Information Systems Book, July 2002.
Naval Research Laboratory Contribution Number NRL/BC/7440—02-1003.
Book Chapter 1 (Refereed), Pages 1-19.

(Ladner)

USING WAVELET TRANSFORMS IN 3D MAPPING

Ladner, R. Sample, J. Shaw, K.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

The Naval Research Laboratory's Digital Mapping, Charting and Geodesy Analysis Program is investigating the application of wavelet technology to terrain approximation in 3D mapping. The wavelet transform allows us to obtain the frequency content of gridded elevation data while retaining the spatial context. We use a 2D discrete wavelet transform (DWT) to reduce Digital Terrain Elevation Data (DTED) to low and high frequency components. The low frequency components represent widespread fluctuations in terrain and over large areas give a very close approximation to the original data set. Each application of a wavelet transform gives us a 75% reduction in the amount of data that must be displayed. A level 2, 2D DWT allows us to represent large amounts of terrain data with only 6.25% of the original data. A reverse transform on the reduced data set makes possible the restoration of any level up to the original data with only minor loss, making the application suitable for multi-resolution systems. This application is also ideal for time-critical applications. Processing 1,073,179 DTED elevations down to 67,304 takes approximately one-half second. Optimized triangulated irregular network algorithms are reported to require over 45 seconds for a similar sized data set. We describe the application of wavelet technology to Internet-based 3D mapping. In addition to custom 2D maps that may consist of vector, raster and gridded data, users may generate 3D maps by area-of-interest.

Keywords: 3D Mapping, 3D Synthetic Environment, Terrain Modeling, Wavelet Transform

Sponsored by the National Guard.

Presented at the Aero Sense Conference, April 1-9, 2002, Orlando, FL.
Naval Research Laboratory Contribution Number NRL/PP/7440--02-1005.
Conference Proceedings
8 Pages

(Lohrenz)

A PILOT-CENTERED EVALUATION OF EVALUATION OF GEOSPATIAL DATA FOR PROPOSED NAVAL HELICOPTER MOVING-MAP DISPLAYS

Lohrenz, M. Trenchard, M. Edwards, S.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004
Collins, C.
Naval Research Laboratory
Washington, DC 20375

Abstract

Cockpit moving-maps have provided heightened situation awareness to Navy fighter pilots for over ten years. The Navy now plans to install a moving-map into its multifunction MH-60S helicopter, which will perform sea-based missions such as combat search and rescue and mine countermeasures. The authors surveyed 49 Navy helicopter aircrew for their preferences with respect to four map types and up to six graphic overlays. Participants rated each resultant display for its potential to support naval helicopter missions. Aeronautical charts were rated highest, followed by bathymetric displays, nautical charts, and acoustic imagery. Preferred overlays
included flight path, threat rings, historical mine data and seafloor bottom type.

Keywords
Moving-map displays, naval helicopters, human factors

Sponsored by the Office of Naval Research.

Presented at the International Conference On Human-Computer Interaction In Aeronautics (HCI-Aero 2002), October 23-25, 2002, Cambridge, MA.
Naval Research Laboratory Contribution Number NRL/PP/7440–02-1011.
Conference Proceedings (Refereed)
6 Pages

(Lohrenz)

AN EVALUATION OF VECTOR GEOSPATIAL DATABASES IN COCKPIT MOVING-MAP DISPLAYS TO IMPROVE PILOT PERFORMANCE

Lohrenz, M. Trenchard, M.
Myrick, S. Edwards, S.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

Today's military pilots are bombarded with information from moving-maps and other advanced cockpit displays. Current moving-map displays in the AV-8B *Harrier* and F/A-18 *Hornet* naval aircraft are based on scanned aeronautical charts, which are familiar to pilots but present an unalterable - and sometimes illegible - display. When mission-planning symbols (i.e., targets, threats, routes, etc.) are overlaid on these scanned-map displays, the result can be extremely cluttered. In contrast, the advent of "vector" geospatial databases offers the potential for customized moving-maps, in which user-specified geospatial features can be layered (with or without a base-map, such as satellite imagery) to suit specific mission requirements. The primary disadvantage of vector-based cockpit moving maps is the potential for increased pilot workload, unless these new map displays are carefully designed for the target user.

The Naval Research Laboratory (NRL) is conducting a study for the Naval Air Systems Command to demonstrate and evaluate layered, vector-based, moving maps to determine if they can provide improved tactical situational awareness to the naval aviator. All map data under consideration are National Imagery and Mapping Agency standard products, including Vector Map Levels 0 and 1 databases, Vertical Obstruction Data, and Electronic Chart Updates. This effort will build on previous NRL and Naval Air Warfare Center studies that focused on pilot preferences for various cockpit moving-map displays. This study will first establish the design of vector-based moving-map scenarios based on aircrew preferences, and then attempt to correlate pilot performance measures with the preference data.

Much of the data for this study will be gathered via Internet, to broaden participation and minimize the evaluation's impact on participants' normal operational duties. The on-line study is two-fold: (1) a survey of combat pilots, aircrew, and requirements officers to identify the most promising map data types for mission-driven vector-based moving map displays, and (2) an evaluation of interactive moving-map simulations. Part 1 will gather preference data to assist in the design of the vector-based moving-map scenarios for part 2. Part 2 will measure pilot performance to mission objectives (e.g., deviation from flight path, time-to-locate target, etc.) and correlate this performance with initial preferences.

This paper presents a design overview of the NRL vector moving-map study, as well as relevant results from our earlier preference study, emphasizing the potential impacts (both positive and negative) of customizable cockpit map displays on pilot performance, such as map flexibility *vs.* pilot workload.

Keywords: maps / charts; displays; geospatial databases; situation awareness; aviation.

Sponsored by Naval Air Systems Command.

Presented at the Human Performance, Situation Awareness and Automation: User-Centered Design For The New Millennium, October 15-19, 2000, Savannah, GA.
Naval Research Laboratory Contribution Number NRL/PP/7440–00-0014.
Conference Proceedings (Refereed)

(Lohrenz)

AN ON-LINE EVALUATION OF COCKPIT MOVING-MAP DISPLAYS TO ENHANCE SITUATION AWARENESS IN ANTI-SUBMARINE WARFARE AND MINE COUNTERMEASURES OPERATIONS

Lohrenz, M. Trenchard, M. Edwards, S.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

Cockpit moving-map systems have provided heightened situation awareness to the fighter pilot for more than ten years, but these systems have yet to be integrated into military helicopters. The Navy now plans to install a moving-map system into its new, multi-functional MH-60S helicopter, which will perform mine countermeasures (MCM), combat search and rescue, special operations, and logistics. Other H-60 variants (e.g., SH-60B) perform anti-submarine warfare (ASW), surface warfare, surface surveillance, and other missions.

Naval Research Laboratory scientists were tasked to demonstrate and evaluate the potential of a cockpit moving-map for enhanced situation awareness during multi-functional helicopter missions (particularly MCM and ASW). This project consisted of three main tasks: 1) conduct a web-based survey of pilots and aircrew experienced in MCM and ASW for their preferences with respect to various environmental data that could be displayed in a moving-map; 2) demonstrate and evaluate pilot-preferred data on existing moving-map displays; and 3) recommend potential data types to be collected and displayed in a multi-mission helicopter.

This poster presents preliminary results from our survey of helicopter aircrew, as well as sample map displays. A total of 60 pilots, airborne tactical officers and sensor operators responded to the on-line survey. The participants represented five different helicopter platforms: HH-60H (6 pilots), MH-53E (2), MH-60S (I), SH-60B (45), and SH60F (5). One P-3 (fixed-wing) pilot also responded. Four map types were evaluated: scanned aeronautical charts, nautical charts. gridded bathymetry, and acoustic imagery of the seafloor. Six potential overlays also were evaluated: flight path, tow fish location, tow fish depth, sediment bottom type (e.g., sand, mud, rock), threat rings, and historical data (e.g., known non-mine objects). The Office of Naval Research sponsored this project as part of the Naval Research Laboratory's Generation and Exploitation of the Common Environment (GECE) Program.

Sponsored by the Office of Naval Research.

Presented at the HCI International 2001 9th International Conference on Human-Computer Interaction, August 5-10, 2001, New Orleans, LA.
Naval Research Laboratory Contribution Number NRL/PP/7440--01-1008.
Conference Proceedings
3 Pages

(Lohrenz)

AV-8B MAP SYSTEM II: MOVING-MAP COMPOSER VERSION 3.3 SOFTWARE USERS' MANUAL (2ND EDITION)

Lohrenz, M. Gendron, M. Myrick, S.
Mehaffey, J. Trenchard, M. Wischow, P.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

This report documents the Moving-Map Composer (MMC) software system developed by scientists in NRL Code 7440.1. This is the second edition of the MMC Users' Manual (the first edition is NRL/FR/7441(97-9677) and reflects changes that were implemented for the latest release (version 3.3) of MMC.

The MMC software is resident on the Map II Station portion of the AV-8B Mission Support System, which NRL designed and configured in support of AV-8B mission planners and pilots in the field. MMC enables users to perform the following functions:

* Design and build Aircraft Optical Disk (AOD) images from user-specified Compressed Aeronautical Chart (CAC) and scanned chart data;
* Include emergency check-lists and reconnaissance photographs in an AOD image;
* Write completed AOD images to militarized Write-Once Read-Many AODs;
* Evaluate failed AODs and recover from failed AOD image builds;
* Design and build Mission Planning System Compact Disk Images (MPS-CDIs) from user-specified CAC, scanned chart, and DTED data;
* Write MPS-CDIs to Recordable Compact Disk (CD-R) for mission planning purposes;
* Scan and compress paper charts into a CAC-compatible format (when CAC or Arc Digitized Raster Graphics (ADRG) are not available) and include them in an AOD image or MPS-CDI.
* Print final compositions, CAC images, checklists, and AOD summaries (new function in MMC version 3.3).

The AV-8B Map II Stations have completely replaced all map data functions and all optical disk image functions that previously were handled by the AV-8B Map, Operator, and Maintenance Stations (MOMS). To date, the AV-8B program has purchased eight NRL-developed Map-II Stations (including two for the Spanish AV-8B and one for the Italian AV-8B), and the F/A-18 program has purchased two.

Sponsored by Naval Air Systems Command.

Published June 30, 2000.
Naval Research Laboratory Contribution Number NRL/FR/7440–00-9938.
NRL Formal Report

(Lohrenz)

DEMONSTRATING A MOVING MAP SYSTEM FOR IMPROVED LANE NAVIGATION AND SITUATIONAL AWARENESS

Lohrenz, M. Gendron, M. Edwards, S.
Mang, R. Myrick, S. Trenchard, M.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

Amphibious landing operations conducted in a mined environment require assault lanes that are either cleared of mines, or avoid mined areas. The magnitude of time and effort required to clear mined areas depends upon the aggregate width of the lanes to be cleared. To a considerable degree, lane width is determined by the ability of amphibious assault vehicles to navigate within lanes. Therefore, assault vehicles with more precise navigation capabilities support reduced lane clearance requirements. NRL has developed a Moving-Map navigation system for amphibious assault vehicles to study improvements in lane navigation and situational awareness. The Moving-Map system utilizes the Differential Global Positioning System, electronic charts, and Battlefield Geometry displays to facilitate more precise lane navigation and enhanced situation awareness, thereby reducing aggregate lane width requirements for mine clearance. This study was conducted using the Amphibious Assault Vehicle, the Landing Craft Utility vessel, and the Landing Craft Air Cushion vessel. This study seeks to demonstrate the utility of this technology and obtain measurements to quantify improvements.

Sponsored by the Office of Naval Research.

Presented at the Oceans 2002 Conference and Exhibition, October 29-31, 2002, Biloxi, MS.
Naval Research Laboratory Contribution Number NRL/PT/7440--02-1003.
Conference Poster
1 Page

(Lohrenz)

HUMAN FACTORS ISSUES IN ADVANCED MOVING-MAP SYSTEMS

Ruffner, J.
DCS Corporation
Alexandria, VA 22193
Lohrenz, M. Trenchard, M.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

Vector-based maps are an advanced capability of digital moving map Systems that are easily customized and can be powerful aids to aircrew information processing and decision-making. However, they may place excessive demands on an aircrew' s information processing requirements, increase workload, and degrade situational awareness if the user interface is not designed properly. There is little information available about the human factors and situational awareness issues relevant to vector-based maps. In this paper we summarize relevant research on human factors and situational awareness aspects of vector-based maps, identify key issues, and recommend directions for future research.

Key Words: digital moving maps, vector maps, human factors, situational awareness

Sponsored by the U.S. Navy's Tactical Aircraft Moving Map Capabilities (TAMMAC) Program.

Published in the *Journal of Navigation,* January 2000.
Naval Research Laboratory Contribution Number NRL/JA/7441–99-0023.
Journal Article (Refereed)

(Lohrenz)

INTERNET-BASED SURVEYS AND ON-LINE EVALUATIONS OF DIGITAL MOVING-MAP DISPLAYS FOR MILITARY AIRCRAFT

Lohrenz, M. Edwards, S. Myrick, S. Gendron, M. Trenchard, M.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

This paper discusses the design and preliminary development of two Internet-hosted surveys of military pilots and aircrew to evaluate geospatial data and display scenarios for mission-driven, cockpit moving-maps. The Naval Research Laboratory (NRL) is conducting these surveys in support of two primary Navy sponsors: the *Tactical Aircraft Moving Map Capability* program and the *Generation and Exploitation of Common Environment* program.

The goal of the first survey is to demonstrate and evaluate the situational awareness potential of vector-based moving maps in cockpit displays. Current moving-map displays in naval aircraft are based on scanned (i.e., raster) charts, which are familiar to pilots but present an unalterable, often-cluttered, and sometimes illegible display. In contrast, vector geospatial databases offer the potential for customized map displays, in which cartographic features can be layered to suit mission requirements. The potential disadvantage of vector-based cockpit moving maps is increased pilot workload, unless the displays are carefully designed for the target user.

The goal of the second survey is to determine whether cockpit moving-maps offer any potential to improve situational awareness for pilots who fly Mine Counter-Measures and Anti-Submarine Warfare missions and, if so, which map and imagery databases would be most useful to this community.

Both surveys are being conducted via Internet to broaden participation and minimize the survey's impact on participants' normal operational duties. Due to time and funding constraints, previous efforts were limited to the number of participants stationed at a specific location during the scheduled survey. As a result, there were not enough participants to yield statistically significant results for the evaluations. Previous efforts also were hampered by a dependency on dedicated interviewers during the entire evaluation process. The current web-based approach is expected to reach a much wider population within a short timeframe and it does not require dedicated personnel or facilities to conduct the evaluation. Once established, this approach can be tailored to support future geospatial product evaluations.

Each Internet-hosted survey utilizes an interactive JAVA-based web site and is comprised of a series of questions to evaluate selected geospatial data types. The web site displays standard MPEG-formatted movie loops depicting appropriate mission scenarios and dynamically assimilates survey results into a Microsoft Access database.

Computer science and human factors considerations to be addressed in this paper include:

- How to best design the Internet-based surveys to return statistically valid results?
- How to present realistic, real-time "moving-map" displays for a web-hosted evaluation?
- How to use web-based simulations to correlate geospatial data with mission effectiveness?
- How to attract participation from the targeted user-groups and focus the survey's results? How to use the Internet-based survey data to design and develop the resultant systems?

Sponsored by the Naval Air Systems Command and the Office of Naval Research.

Presented at the Southern Conference on Computing, October 26-28, 2000, Hattiesburg, MS.
Naval Research Laboratory Contribution Number NRL/PP/7440—00-1002.
Conference Proceedings

(Lohrenz)

MOVING-MAP SUPPORT TO ASW/MCM OPERATIONS

Lohrenz, M. Trenchard, M.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

Demonstrate and evaluate potential ASW and MCM functionalities of a cockpit-based moving-map system in anti-submarine warfare (ASW) and mine-hunting operations.

Sponsored by GECE.

Presented at the TAMMAC Users' Group Conference, February 8, 2001.
Naval Research Laboratory Contribution Number NRL/OP/7440—01-1001.
Oral Presentation

(Lohrenz)

PILOT PREFERENCES ON VECTOR MOVING-MAP DISPLAYS

Lohrenz, M. Myrick, S. Trenchard, M.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004
Ruffner, J.
DCS Corporation
Cohan, T.
University of Southern Mississippi
Hattiesburg, MS

Abstract

Vector map databases offer the potential for customized cockpit moving-map displays, in which user-specified cartographic features can be layered to meet mission requirements. The disadvantage of vector moving-maps is the potential for increased user workload. In 1995, the Naval Research Laboratory and the Naval Air Weapons Center jointly performed a preference study, during which aircrew viewed demonstrations of prototype moving-map displays and responded to a detailed questionnaire concerning the usefulness of each display. This paper summaries aircrew interviews from that study pertaining to both vector moving-map displays and vector feature overlays, including Height-Above Threshold (HAT), threat rings, and Clear Line-of-Sight (CLOS).

Sponsored by US Navy's Tactical Aircraft Moving Map Capability (TAMMAC) and the Naval Air Warfare Centre-Aircraft Division.

Published in *Journal of Navigation,* January 2000, Pages 93-113.
Naval Research Laboratory Contribution Number NRL/JA/7440—00-0002.
Journal Article (Refereed)

(Lohrenz)

PROCEEDINGS OF THE NRLSSC SYMPOSIUM ON VECTOR MOVING MAP DISPLAY

Lohrenz, M. Myrick, S.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004
McMurray, LT. M.
NRL Navy Reserve Unit 108

Abstract

A multi-disciplinary symposium focusing on technical issues related to vector moving-map displays, such as software and database design, vector data compression, and providing real-time vector-based information to the cockpit. The conference also addressed human factors and situational awareness issues inherent in the optimum design of vector map displays.

Sponsored by the Naval Research Laboratory.

Compilation of papers presented at the Vector Moving Map Symposium, August 3-4, 1999, Alexandria, VA.
Naval Research Laboratory Contribution Number NRL/PP/7441—00-0008.
Conference Proceedings (Refereed)
On CD

(Lohrenz)

WEB SITE – MOVING MAP COMPOSER TEAM WEB SITE

Lohrenz, M. Gendron, M.
Myrick, S. Trenchard, M.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004
Ioup, J.
University of New Orleans
New Orleans, LA

Abstract

The Moving-Map Composers (MMC) Team (Code 7440.1) is part of the Mapping, Charting & Geodesy Branch of the Naval Research Laboratory at the Stennis Space enter, MS. The Team mission is to support the U.S. Navy, Marine Corps, and other agencies with moving-map displays and map design systems for tactical aircraft, Uninhabited Aerial Vehicles (UAV) and other platforms. This web site provides an overview of the MMC Team, including brief descriptions of major projects, sponsors and lists of publications. Sub-webs leading from the main web site include on-line help for the MMC software system, Aircraft Optical Disk inventory reports, and Proceedings from the MMC Symposium on Vector Moving-Map Displays, held in August 1999. These sub-webs are only accessible via authorized username and password.

Sponsored by NAVAIR PMA-265 (F/A-18), PMA-257 (AV/8B), and PMA-209 (TAMMAC).

Published as a Naval Research Laboratory Web Page, January 11, 2000.
Naval Research Laboratory Contribution Number NRL/OP/7440—00-0004.
NRL Web Page

(Lybanon)

SHOALING WAVES SUMULATOR

Lea, S.
University of North Carolina at Greensboro
Greensboro, NC 27402-6170
Lybanon, M.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

Oceanographic studies of near-shore processes frequently require remotely sensed images to provide data. In particular, the Navy is interested in using remotely sensed images to determine water depths in littoral areas, in connection with amphibious operations. Because coastal areas can suffer rapid depth changes due to sedimentation or dredging, the problem of fast and current depth determination is important.

Waves are described by a frequency f and a wavelength λ. The wave number $k = 2\pi/\lambda$ and the angular frequency $\omega = 2\pi f$ are also used; **k** points in the direction of travel of the wave. The wave phase speed is given by $c = \omega/k$. Remotely sensed images of the ocean can be used to infer depths in two ways. The bottom reflectance method uses stereo pairs of images. Wave clutter is removed, and the locations of bottom features in a stereo pair are used to infer depths. Inversion of the linear dispersion relation for waves, $\omega^2/g = k \tanh kh$, provides the depth function h using one of two methods. The first method uses a single image of wave crest positions that includes both deep water and shallow water. Wavelength is measured as crest spacing. The wave-number value in deep water, $k = \omega^2/g$, determines ω. The second method uses a time sequence of images of wave crests, which need not extend to deep water. Wavelengths are again measured as crest spacing; wave phase speed is determined from the distance a crest moves in the time between two images in the sequence. Because $c = \omega/k$, the speed determines ω. (The time interval between images must be less than one wave period, to enable following a single wave crest unambiguously.)

Although sensors and techniques have improved over the last 50 years, the errors in depths obtained by inverting the dispersion relation have remained approximately constant at 0.5 m (1-6). There are several possible causes of these errors:

- Real waves do not obey the linear dispersion relation.
- Sensor noise is of this magnitude.
- Remote sensing issues [e.g., the image acquired is some (unknown and complex) function of sea surface height].
- Poor analytical techniques.
- Real ocean waves are superpositions of simple waves of many different frequencies.

To identify the major sources of this error and because of the lack of good data with known bottom depths, we have developed a program which produces simulated remotely sensed images of wave crests, either as a single image or as a time sequence of images. The model used is known to obey the linear dispersion relation for all depths. Sensors are not used to acquire the data. The images display wave height directly. Consequently, analysis of these images by several techniques can provide estimates of the contributions of the analytical techniques and the composite nature of ocean waves to the error. Furthermore, because the depth at every point in an image is known, comparisons of inferred values to possibly invalid measured values do not contribute to the error.

Sponsored by the Space and Naval Warfare Systems Command, Dr. S. Payne, Program Manager.

Published in the Encyclopedia Of Computer Science And Technology, Volume 42, Supplement 27, June 2000.
Book Chapter

(Lybanon)

WATER DEPTH DETERMINATION FROM WAVE CREST IMAGES (INVITED)

Lea, S. Kissling, G. O'Dell, T.
University of North Carolina at Greensboro
Greensboro, NC 27402-6170
Lybanon, M.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

Coastal water depths vary over time because of sedimentation and dredging. Rapid determination of water depth near coastal areas is of interest to oceanographers. Time sequences of remotely sensed wave crest images can be used with a semi-automated system for fast depth determination. Our semi-automated system uses techniques of mathematical morphology to identify crests and time stack images to measure wave speeds. For good data, the average results are also good. Our goal is reliable values for individual depth points.

Sponsored by the SPAWAR Command.

Presented at the 2001 IEEE International Symposium on Intelligent Signal Processing and Communication Systems, November 20-23, 2001, Nashville, TN.
Naval Research Laboratory Contribution Number NRL/PP/7440--01-1013.
Conference Proceedings (Refereed)
5 Pages

(McCreedy)

DESIGN OF A NAVAL RESEARCH LABORATORY SYSTEM FOR AREA OF INTEREST ACCESS TO LARGE VOLUMES OF BATHYMETRIC DATA

McCreedy, F. Wilson, R. Shaw, K.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004
Braud, J.
Naval Oceanographic Office
Stennis Space Center, MS 39529

Abstract

The Digital Mapping, Charting and Geodesy Analysis Program (DMAP) of the Naval Research Lab (NRL), in an effort to aid Naval Oceanographic Office (NAVO) data processing needs, has developed a system to spatially index and query bathymetric data stored in Generic Sensor Format (GSF) data files. The GSF data file format has the ability to store various types of data, but in this system only bathymetry, specifically, single-beam and multi-beam bathymetry, is indexed. Bathymetric data is used by NAVO to generate various oceanographic information products. Presently, to obtain bathymetric data for a particular area of interest (AOI) for product generation, NAVO personnel must determine which oceanographic surveys generated bathymetric data files in the AOI and where these files are physically located. Next, they have to download all of these files and process them. Each of these files may have large amounts of data (potentially hundreds of megabytes) that are outside of the given AOI. It is also possible that some files may not have any data in the AOI. Using the spatial indexing ability of Oracle, the NRL-developed system allows NAVO to quickly determine and retrieve only the bathymetric data that is relevant to the AOI, completely automating the process of data acquisition. This system provides benefits by substantially reducing the amount of data that must be considered when producing a product and also by providing users with an intuitive interface to use for data retrieval purposes. This paper will discuss the spatial indexing scheme, spatial querying, the interface for retrieving data, and other components of the NRL system. In addition, problems that were encountered and the time savings provided by this system will be discussed.

Sponsored by SPAWAR PMW 155.

Presented at the Oceans 2002 Conference and Exhibition, October 29-31, 2002, Biloxi, MS.
Naval Research Laboratory Contribution Number NRL/PP/7440--02-1009.
Conference Proceedings
4 Pages

(McCreedy)

SYSTEM DOCUMENTATION FOR THE GEOSPATIAL INFORMATION DATABASE (GIDB™) SYSTEM SERVER VERSION 2.0

McCreedy, F. Ladner, R. Wilson, R. Breckenridge, J.
Carter, S. Mesick, H. Olivier, D. Shaw, K.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004
Baribault, C. Lovitt, T.
Planning Systems Inc.
Slidell, LA 70458

Abstract

The Geospatial Information DataBase System (GIDB™) offers a fully Object Oriented (OO) database approach to managing the input, storage, retrieval, and presentation of geospatial data in relation to a specific user defined area of interest (AOI). It uses both public domain and commercial OO database management systems (DBMS) technology to store and retrieve the data and can present this information in both 2D and 3D perspective views. It also offers the flexibility to query spatial data with reference to time and space.

The GIDB utilizes the Java™ programming environment to structure, retrieve and manipulate digital representations of real world phenomena as points, lines, polygons and raster objects. Most often it uses open source OO-DBMS, (e.g., Ozone) or commercial Hybrid Relational/OO-DBMS (e.g., Oracle®) as the data storage mechanism for its object structure. A primary goal of the GIDB is to foster the advancement of Geospatial Information Technology (GIT) by encouraging the use of advanced OO database techniques for spatial data storage, retrieval and presentation. GIDB constitutes a more integrated approach to spatial data architectures and encourages the development of new and improved techniques for defining both spatial and temporal relationships among real world data entities. This document describes the common steps involved with the installation; maintenance and update of the GIDB System Server on most Microsoft Windows™ based Server systems.

Sponsored by the National Guard Bureau-CounterDrug Office.

Published as a Naval Research Laboratory Memorandum Report, June 24, 2002.
Naval Research Laboratory Contribution Number NRL/MR/7440--02-8275.
NRL Memorandum Report
19 Pages

(McDowell)

CONTROL/LEARNING ARCHITECTURES FOR USE IN ROBOTS OPERATING IN UNSTRUCTURED ENVIRONMENTS

McDowell, P. Gendron, M.
Bourgeois, B. Sample, J.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004
Iyengar, S.
Louisiana State University
New Orleans, LA

Abstract

This paper describes work being conducted at the Louisiana State University Robotics Research Laboratory towards the development of legged robot walking algorithms for unstructured environments. This work is associated with the Robo-Tiger project whose goal is the construction of a life-size robotic tiger mascot with the physical attributes of a real tiger. The focus of this research is on robots with multi-jointed legs and the goal is to develop algorithms and architectures capable of learning new walking patterns to allow autonomous compensation for varying and unknown terrains. This paper describes the project developments to date and the details of the approaches being proposed to enable a legged robot to cope with uncertain terrains.

No Sponsor per Brian Bourgeois.

Presented at the Southern Conference On Computing, October 26-28, 2000.
Naval Research Laboratory Contribution Number NRL/PP/7440--00-1008.
Conference Proceedings

(McDowell)

OBJECTIVE BASED DYNAMIC NAVIGATION PLANNING

McDowell, P. Bourgeois, B.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004
Cheramie, J. Gravley, J.
C&C Technologies, Inc.
Lafayette, LA 70508

Abstract

This paper discusses research efforts at the Naval Research Laboratory in the area of environmentally adaptive navigation and dynamic mission planning. Presented in this paper is the system architecture being developed for the accomplishment of objective based dynamic navigation. A simulator is being constructed that incorporates this architecture and its design is presented. This simulator will enable the future development of specific mission behavior modules.

Sponsored by the Office of Naval Research.

Presented at the UUST 2001 International Symposium, August 27-29, 2001, Durham, NC.
Naval Research Laboratory Contribution Number NRL/PP/7440--01-1011.
Conference Proceedings
10 Pages

(McDowell)

UUV TEAMS, CONTROL FROM A BIOLOGICAL PERSPECTIVE

McDowell, P. Bourgeois, B.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004
Chen, J.
Louisiana State University
Baton Rouge, LA

Abstract

Remote Operated Vehicles (ROVs) are used extensively for salvage operations, ocean floor surveying and numerous inspection activities that support a wide range of underwater commercial activities. In deep water (greater than 1000 ft) an ROV is the platform of choice because of the depth and endurance limitations for human divers. The key disadvantage to an ROV is the requirement for the long tether. The tether greatly inhibits the speed of the ROV, requires a ship with deck gear capable of handling this cable, and significantly restricts ship movement while deployed.

Un-tethered Unmanned Underwater Vehicles (UUVs) have entered the commercial market and have demonstrated the ability to perform deep-water surveys faster and cheaper than towed vessels. With further technological advances, UUVs have the potential for supplementing and even replacing ROVs for many deep-water operations because of the cost and problems associated with the tether. One promising scenario for the near future is to use an ROV or surface ship to control multiple UUVs in a local work area. Typically in this scenario the UUVs are used to extend the sensor footprint of the ROV or surface ship.

Another area of interest is the UUV team concept. A stereotypical UUV team would be a heterogeneous mix of several low-cost specific purpose vehicles, guided and supported by one or two higher cost control vessels. Because of the severe restrictions that the sub-sea environment places on communication and positioning, precision underwater navigation is difficult. Currently most precision underwater navigation relies on some sort of infrastructure such as surface ships or underwater beacons placed in known positions. Using these assets as reference-points sub-sea navigation is carried out. Some situations require that the environmental and/or commercial attributes of an area be assessed before an infrastructure exists. In order to do this the UUV team must be able to navigate to an area, carry out its task and return without any pre-existing infrastructure or step by step guidance.

Given basic assumptions about the type and frequency of sensor input we present a biologically inspired, decentralized methodology for safely and efficiently moving a loose formation of UUV's to and from the task area with the goal of minimizing outside guidance.

Sponsored by the Office of Naval Research.

Presented at the Oceans 2002 Conference and Exhibition, October 29-31, 2002, Biloxi, MS.
Naval Research Laboratory Contribution Number NRL/PP/7440--02-1025.
Conference Proceedings
7 Pages

(Mesick)

DIGITAL MAPPING, CHARTING, AND GEODESY ANALYSIS PROGRAM SPATIAL AND TEMPORAL REFERENCE SYSTEMS AND THE 4D3 CONCEPT

Mesick, H. Carter, S. Harris, M.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

A technical review of the Spatial and Temporal Reference Systems and the 4D3 Concept was performed by the Digital Mapping, Charting, and Geodesy Analysis Program (DMAP). Background, discussion points and conclusions are presented.

Sponsored by SPAWAR.

Published through the Naval Research Laboratory, September 30, 2002.
Naval Research Laboratory Contribution Number NRL/MR/7440--02-8282.
Memorandum Report
8 Pages

(Mesick)

DIGITAL MAPPING, CHARTING, AND GEODESY ANALYSIS PROGRAM TECHNICAL REVIEW OF CONSOLIDATED VECTOR PRODUCT FORMAT SPECIFICATIONS AND RELATED DOCUMENTS

Mesick, H. Carter, S. Wilson, R.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

Technical reviews of the Consolidated Vector Product Format Specifications and their Related Documents were performed by the Digital Mapping, Charting, and Geodesy Analysis Program (DMAP). This review consisted of a review of: Vector Product Format MIL-STD-2407 Change Notice 2, General Specifications for VPF Products MIL-PRF-89049A, and Foundation Feature Data MIL-PRF-89049/1. Background, discussion and recommendations and conclusions are presented for each review.

Sponsored by SPAWAR.

Published through the Naval Research Laboratory, September 30, 2002.
Naval Research Laboratory Contribution Number NRL/MR/7440--02-8284.
Memorandum Report
18 Pages

(Mesick)

DIGITAL MAPPING, CHARTING, AND GEODESY ANALYSIS PROGRAM TECHNICAL REVIEW OF TACTICAL OCEAN DATA (TOD) LEVELS 0, 1, 2

Breckenridge, J. Mesick, H. Carter, S. Shaw, K.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

Technical reviews of the Tactical Ocean Data Levels 0, 1, and 2 Performance Specifications were performed by the Digital Mapping, Charting, and Geodesy Analysis Program. Background, discussion and recommendations and conclusions are presented for each review.

Sponsored by SPAWAR.

Published through the Naval Research Laboratory, September 30, 2002.
Naval Research Laboratory Contribution Number NRL/MR/7440--02-8281.
Memorandum Report
14 Pages

(Mesick)

DMAP TECHNICAL REVIEW OF ADDITIONAL MILITARY LAYERS PRODUCT SPECWICATIONS, ED. 4.0

Mesick, H. Breckenridge, J. Carter, S.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

AML is intended to supply supplemental digital cartographic information to standard Electronic Nautical Chart (ENC) / Digital Nautical Chart (DNC) products to increase military applications utility. Six baseline AML draft product specifications were provided:

Contour Line Bathymetry (CLB)
Environment, Seabed and Beach (ESB)
Large Bottom Objects (OBO)
Maritime Foundation and Facilities (MFF)
Routes, Areas and Limits (RAL)
Small Bottom Objects (SBO)

Sponsored by SPAWAR.

Published through the Naval Research Laboratory, June 28, 2002.
Naval Research Laboratory Contribution Number NRL/MR/7440--02-8276.
Memorandum Report
6 Pages

(Mesick)

DMAP TECHNICAL REVIEW OF PROPOSED ICE OBJECTS FOR AML

Mesick, H. Carter, S. Breckenridge, J.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

The United Kingdom Hydrographic Office requested a review of proposals received for incorporating ice objects in to the Additional Military Layers (AML) product. Two proposals were made by the Canadian Ice Service: 1) No amendments are necessary to ice objects in Maritime Foundation and Facilities (MFF) product specification and 2) High Resolution Environment (HRE) (or Environment, Seabed and Beach (ESB)) is revised to bring it into line with the ECDIS Ice Objects Version 3.0, but without extending the scope of HRE. It is noted that MFF and HRE (or ESB) both contain Sea Ice — Ice Area and Land Ice — Ice Area. Separate consideration will be given to removing all ice from MFF to ensure that there is no duplication of data (or to confirming that there are different specifications for different purposes).

For this review, DMAP specifically focused on Annex A of the referenced document which presented the proposed changes to the AML Product Specification HRE to bring it into line with the ECDIS Ice Objects. The following areas are discussed within this review:

- problems of temporal stability
- lack of codes for icebergs
- World Meteorological Organization Ice Chart Symbology "Egg Code"
- AML ice features as compared to DIGEST, SEDRIS, and IHO S-57.

A review of the DIGEST FACC indicated insufficient features and attributes to encode sea ice information. It is the opinion of DMAP that neither the AML objects nor Digital Geographic Information Exchange Standard (DIGEST) are sufficient to handle the required information. We recommend that at a minimum, the features and attributes should permit the encoding of the essential information contained in the World Meteorological Organization (WMO) "Egg Code" (see http ://www.natice.noaa.gov/sigrid.htm and http ://www.natice.noaa.gov/egg.htm for complete specifications).

Sponsored by the Oceanographer of the Navy.

Published through the Naval Research Laboratory, September 28, 2001.
Naval Research Laboratory Contribution Number NRL/MR/7440--01-8269.
Memorandum Report
20 Pages

(Mesick)

DMAP TECHNICAL REVIEW OF TACTICAL OCEANOGRAPHIC DATA LEVEL 4 (TOD4) ASSOCIATED PERFORMANCE SPECIFICATION, MIL-PRF-89049/14 (15 MARCH 2001)

Mesick, H. Carter, S. Wilson, R.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

Tactical Oceanographic Data Level 4 (TOD4) is intended to be a digital replacement for the Hull Integrity Test Sites (HITS) Chart. TOD4 is in the Standard Vector Product Format (VPF) and is designed to he used in conjunction with Digital Nautical Chart (DNC) and TOD2 for complete navigation information.

The intended use is to supplement the electronic chart display systems with detailed classified depth and other information to permit the safe surface and underwater navigation and operation of submarines and their escorts during submarine hull integrity tests. The TOD4 is intended for use by military branches of the government.

Sponsored by SPAWAR.

Published through the Naval Research Laboratory, June 28, 2002.
Naval Research Laboratory Contribution Number NRL/MR/7440--02-8277.
Memorandum Report
10 Pages

(Mesick)

DMAP TECHNICAL REVIEW OF VECTOR DATA UPDATE (VDU) LAYER

Mesick, H. Carter, S. Breckenridge, J.
Wilson, R. Shaw, K.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

The Vector Data Update (VDU) is a standard digital Geospatial Information and Services (GI&S) product used by the National Imagery and Mapping Agency (NIMA) to transmit Digital Nautical Chart (DNC) data updates to Naval Operational Forces, including Navy ships at sea. This review, conducted by the Naval Digital Mapping, Charting & Geodesy (MC&G) Analysis Program (DMAP) at Stennis Space Center, MS, examines the Draft Performance Specification for VDU Layer, dated 3 October 2002.

VDU is designed to provide an update layer that can be distributed along with patch updates. A VDU layer is a Vector Product Format (VPF) coverage that can he added to the underlying VPF data set. It contains geospatial features and attribution that represent any changes made to a DNC data coverage, and identifies the sources of those changes.

The update distributed by NIMA will provide a binary patch update with information for each VPF library. It is designed to flag and distribute additional information about significant changes made since the last database edition of the baseline product [e.g., DNC]. Typically this will include features that are significant for safety of navigation. It will contain information such as Notice to Mariners (NtM) number and accompanying text; current and previous feature IDs, as well as coverage and feature class information.

Sponsored by the Oceanographer of the Navy.

Published through the Naval Research Laboratory, December 10, 2002.
Naval Research Laboratory Contribution Number NRL/MR/7440--02-8291.
Memorandum Report
6 Pages

(Mesick)

DRAFT PRODUCT SPECIFICATION FOR NATO REVIEW, EDITION 2.0

Mesick, H. Carter, S. Breckenridge, J.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

The Additional Military Layers (AML) product being developed under the North Atlantic Treaty Organization (NATO) is intended to supply supplemental digital cartographic information to standard Electronic Nautical Chart (ENC) / Digital Nautical Chart (DNC) products to increase military applications utility. The AML contains six draft product specifications as defined by their thematic layers:

- Maritime Foundation and Features
- Routes, Areas, and Limits
- Contour Lines Bathymetry
- High Resolution Environment
- Large Bottom Objects
- Small Bottom Objects

Sponsored by the Oceanographer of the Navy via SPAWAR PMW 185.

Published as a Naval Research Laboratory Memorandum Report, March 9, 2001.
Naval Research Laboratory Contribution Number NRL/MR/7440—01-8260.
NRL Memorandum Report

(Mesick)

MATT PERFORMANCE SPECIFICATION

Mesick, H. Carter, S.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

The MATT Performance Specification being reviewed is similar to the Digital Nautical Chart (DNC) and Tactical Ocean Data (TOD) specifications, with specific Chief of Naval Operations (CNO) Special Chart features added for submarine navigation support data and is specifically intended to support the U.S. Navy requirements for subsurface digital navigation data to support the Navigation Sensor System Interface (NAVSSI). MATT portrays strategic information in support of naval operations. The MATT is based on the feature content of the hardcopy Harbor, Approach, Coastal and General charts and on the DNC, both produced by NIMA, augmented by additional information.

Sponsored by the Oceanographer of the Navy via SPAWAR PMW 185.

Published as a Naval Research Laboratory Memorandum Report, March 9, 2001.
Naval Research Laboratory Contribution Number NRL/MR/7440—01-8261.
NRL Memorandum Report

(Morgan)

A PARAMETERIZED MODEL FOR POINT-TO-EVENT DISTANCES OF REGULAR POINT PATTERNS

Morgan, L. Myers, L.
Tulane University
New Orleans, LA
Bourgeois, B.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

The null model for a two-dimensional point pattern is that of complete spatial randomness (CSR). The null hypothesis assumes that a homogeneous planar Poisson point process produced the point pattern. The point-to-event distance for a point pattern produced under CSR has been shown to follow an exponential distribution with cdf F(r) = 1 - exp(-lpr2), r ^{3} 0 where 1 is the intensity of the process and r is the distance from any arbitrary point in the study area to the nearest point in the pattern. The goal of this research is to determine if a two-parameter Weibull distribution with an increasing hazard rate provides a good fit for the point-to-event distance of regular point processes. Various regular processes are simulated and the fit of a two-parameter Weibull distribution for each pattern is determined by Monte Carlo simulation.

Sponsored by Tulane University.

Presented at the Eastern North American Region (ENAR) Conference, March 25-28, 2001.
Naval Research Laboratory Contribution Number NRL/PP/7440--01-1001.
Conference Proceedings

(Morgan)

DISTRIBUTION FITTING OF A REGULAR POINT PROCESS

Morgan, L. Martinez, A. Myers, L.
Tulane University
New Orleans, LA
Bourgeois, B.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

The Naval Research Laboratory at Stennis Space Center, MS is developing a terrain-based navigation system that uses multibeam bathymetry to estimate the position of an autonomous underwater vessel (AUV). A maximum likelihood approach is used to find the most likely position of the vessel based upon the vehicle's last estimated position, its current measured ocean depth and a bathymetry map of the area. The bathymetry point from the map that most closely matches the vessel measured ocean depth is used as the estimate of the vessel's position.

A parameterized model is needed to quantify the lower bound on the estimated position error for the terrain-based navigation system being developed. The current research is concerned with the characterization of the point pattern produced by multibeam sonar systems and with the development of a parameterized model for the point-to-event distance distribution. The parameterized model will provide confidence intervals for the expected distance to the nearest bathymetry point from any arbitrary point and give an estimate of the average positioning error that would be observed if the system always picked the nearest bathymetry point from the vessel's true location.

The proposed model was developed by first testing the null hypothesis of complete spatial randomness on a sample bathymetric data set. The null hypothesis of complete spatial randomness, the tests used to evaluate this null hypothesis, and the results of these tests are discussed in the next section. The third section describes the process used to select an appropriate parameterized point-to-event model. A two-parameter Weibull distribution was found to provide a reasonably good fit to the observed data. The fourth section investigates the generalizability of the Weibull model. The last section discusses future work and summarizes the findings to date.

Sponsored by the Office of Naval Research.

Presented at the American Statistical Association Annual Meeting, August 5-9, 2001.
Naval Research Laboratory Contribution Number NRL/PP/7440--01-1006.
Conference Proceedings
6 Pages

(Morgan)

STATISTICAL CHARACTERIZATION OF MULTIBEAM BATHYMETRY DATA

Morgan, L.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004
Martinez, A. Myers, L.
Tulane University
New Orleans, LA
Bourgeois, B.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

Multibeam sonar systems produce high-density depth data of the ocean floor. Point pattern analysis of the individual depth points is conducted to determine an appropriate parameterized point-to-event distance distribution, F(y). This distribution is needed to quantify the lower bound on the estimated position error of a terrain-based navigation system being developed. The null hypothesis assumes that a Poisson point process produced the two-dimensional pattern. Under the null, F(y) has been shown to follow an exponential distribution where y is the distance from any arbitrary point in the study area to the nearest point in the pattern. Several tests of the null hypothesis are conducted. These tests lead to a rejection of the null in favor of a regular alternative. Probability plots and likelihood ratio tests arc used to suggest an appropriate distribution, F(y), for the regular point pattern. These tests suggest that a two parameter Weibull distribution with increasing hazard rate may be an appropriate model. Monte Carlo simulations are conducted to determine goodness-of-fit of the Weibull model.

Sponsored by the Office of Naval Research.

Presented at the Joint Statistical Meetings 2001 Conference, August 5-9,2001, Atlanta, GA. Conference Proceedings

(Myrick)

THE DESIGN AND DEVELOPMENT OF AN INTERNET-BASED GRAPHICAL USER INTERFACE USING A COMMERCIAL DESIGN TOOL AND JAVA

Myrick, S. Gendron, M. Lohrenz, M. Edwards, S.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

This paper presents the design and development of an Internet-hosted Graphical User Interface (GUI) to plan digital aeronautical chart coverages (for cockpit moving-map displays) by U.S. military aircraft mission planners, requirements officers, and aircrew. The Naval Research Laboratory at the Stennis Space Center (NRLSSC) is creating this product in support of the Naval Air Systems Command AV-8B and F/A- 18 aircraft programs. The GUI is a component of the NRLSSC-developed Moving-Map Composer (MMC) software. MMC performs a wide variety of aeronautical chart planning functions, including the design and construction of chart images from user-specified data for use in naval mission planning systems and in-flight moving-map displays. The software also facilitates the inclusion of digitized emergency checklists and reconnaissance photographs prior to writing the data to militarized Aircraft Optical Disks (AOD).

X-Designer is a commercial GUI design tool (offered by Imperial Software Technology) that produces source code for the GUI designs created. X-Designer originally was used to produce an X Windows-based version of MMC and was proven to be an excellent tool for generating X Library (Xlib) and OSF/Motif source code. MMC is comprised of C functions and X-Designer generated code and is implemented as a standalone system on a Compaq Alpha workstation running OpenVMS. A new version of MMC (due to be released in early 2001) will also run on a PC platform running Linux. Peripheral devices for performing optical disk operations are included as part of the system hardware configuration.

Since its inception, MMC has undergone numerous software revisions to provide increased support to the fleet and, as a result, now is in greater demand. However, MMC is only available to those who have access to an Alpha workstation and the requisite peripheral devices, which are expensive to maintain and nearly obsolete in terms of CPU speed, memory, disk storage, etc. While the Linux PC version of MMC will help to alleviate obsolescence problems, many pilots and mission planners do not have access to these platforms, either. Therefore, NRLSSC scientists are starting to redesign MMC into a web-based system that would provide structural and platform independence. There are two principle benefits of this redesign: (1) As a web-based system, MMC will be accessible to a substantially greater number of users, primarily pilots and mission planners; (2) As a portable system, MMC no longer will be tied to any one hardware platform and will benefit from newer, faster hardware and peripherals as they become available.

Software implementations using X-Windows, JAVA and C programming languages will meet these needs. NRLSSC scientists are utilizing the most recent version of X-Designer *(v5.5)* - which generates JAVA code - to generate the GUI portion of MMC in JAVA and 0SF/Motif. This paper addresses some of the problems encountered while using JAVA, 0SF/Motif source code, and GUI code conversion (e.g., the use of form attachments), as well as GUI development issues for web usage. Two companion papers being presented at this symposium address (1) the design and implementation of the JAVA Server portion of this MMC redesign, and (2) the design of JAVA-based moving-map simulations, on-line surveys and databases to solicit evaluations of future moving-map displays from pilots and mission planners stationed around the world.

Sponsored by the Naval Air Systems Command.

Presented at the Southern Conference on Computing, October 26-28, 2000, Hattiesburg, MS.
Naval Research Laboratory Contribution Number NRL/PP/7440—00-1010.
Conference Proceedings

(Myrick)

THE DESIGN AND DEVELOPMENT OF GRAPHICAL USER INTERFACES TO CONSOLIDATE MANAGEMENT TASKS ASSOCIATED WITH NAVY AIRCRAFT OPTICAL DISKS

Myrick, S. Gendron, M. Trenchard, M.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

This paper presents the design and development of a series of Graphical User Interfaces (GUI) that are used to build and manage aircraft optical disk images by U.S. military aircraft mission planners, requirements officers, and aircrew. The Naval Research Laboratory at the Stennis Space Center (NRLSSC) has created this product in support of the Naval Air Systems Command Hornet and Harier Programs (PMA-265 and PMA-257, respectively). The GUIs are a component of NRLSSC's Moving-Map Composer (MMC) software that performs a wide variety of mission planning and aircraft image functions including the design and build of Mission Planning System Compact Disk Images and Aircraft Optical Disk (AOD) images. These images are comprised of user-specified digitized charts, static, non-georefererenced dataframes containing emergency checklist procedures and reconnaissance photographs. MMC is an X Windows/Motif GUI and low-level C language application written by NRLSSC scientists, and implemented on a Compaq Alpha computer running OpenVMS. The Navy and Marine Corps employ a large number of AODs in support of their various missions and require a system to manage, build, and edit the images they contain. This paper will address the GUI design and development issues raised during this project and the methods that were developed for their resolution.

Sponsored by the Naval Air Systems Command.

Presented at the Mississippi Academy of Sciences Annual Meeting, February 21-22, 2002, Biloxi, MS.
Naval Research Laboratory Contribution Number NRL/AB/7440—00-1007.
Abstract
1 Page

(Myrick)

THE DESIGN OF AN INTERNET-BASED SURVEY AND EVALUATION OF DIGITAL MOVING-MAPS FOR MILITARY AIRCRAFT

Myrick, S. Edwards, S. Lohrenz, M. Gendron, M.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

This poster presents the design and preliminary development of Internet-hosted surveys of combat pilots, aircrew, and requirements officers to identify the most promising map data types and display scenarios for mission-driven moving-map displays. Results are expected to drive the enhancement of current aircraft map displays to provide improved situational awareness to the aviator. The Naval Research Laboratory (NRL) is conducting these surveys in support of two primary sponsors: the Naval Air Systems Command Tactical Aircraft Moving Map Capability (TAMMAC) Integrated Product Team, and the Office of Naval Research sponsored Generation and Exploitation of Common Environment (GECE) program.

These efforts are building on previous NRL and Naval Air Warfare Center studies that focused on pilot preferences for various cockpit moving-map displays. The purpose of the surveys presented in this poster is to establish the design of mission-driven moving-map scenarios based on pilot preferences. A follow-on study will correlate pilot performance with pilot preference.

Both surveys are being conducted via the Internet to broaden participation and minimize the survey's impact on participants' normal operational duties. Due to time and funding constraints, previous efforts were limited to the number of participants stationed at a specific location during the scheduled survey. As a result, there were not enough participants to yield statistically significant results for the evaluations. The previous efforts also required dedicated interviewers during the entire evaluation process. The current web-based approach is expected to reach a much wider population within a short timeframe and it does not require dedicated personnel or facilities to conduct the evaluation. Once established, this approach can be tailored to support future geospatial product evaluations.

Each internet-based survey utilizes an interactive JAVA-based web-site and is comprised of a series of questions to evaluate various map data types and gather preference data to assist in the design of the mission-driven moving-map scenarios. The web site also employs HTML to run standard MPEG-formatted movie loops depicting various mission scenarios, and to assimilate survey results into a Microsoft Access database.

A companion paper being presented at this symposium addresses the potential impacts of interactive cockpit moving-map displays to pilot performance. This poster addresses human performance issues associated with the Internet-based evaluation itself. Critical human factors considerations that are being addressed during this project include the following:

- How best to design the Internet-based surveys to return the most valid results?
- How to present realistic, interactive "moving-map" displays for a web-hosted evaluation?
- How to use web-based, interactive simulations to evaluate the contribution of specific geospatial layers to mission effectiveness?

Sponsored by NAVAIR PMA-265 (F/A-18), PMA-257 (AV/8B), and PMA-209 (TAMMAC).

Published at the Human Performance, Situation Awareness and Automation: User-Centered Design For The New Millennium, October 15-19, 2000.
Naval Research Laboratory Contribution Number NRL/OP/7440—00-0008.
Abstract

(Myrick)

THE MOVING-MAP COMPOSER: A GUI-BASED MAP DESIGN SYSTEM FOR NAVY AVIATORS

Myrick, S. Gendron, M.
Lohrenz, M. Watkins, J.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

Navy aviators require current, accurate, and easily accessible digital chart data to drive aircraft moving-map displays and provide enhanced situation awareness in the cockpit. In support of this requirement, scientists from the Naval Research Laboratory have developed a software tool known as the Moving Map Composer (MMC) to help pilots and mission planners design and build mission-specific, digital, aeronautical chart coverages. MMC plays a major role as a human-computer interface by enabling pilots to effectively perform a wide variety of aeronautical chart planning functions, including the design and construction of chart images from user-specified data for use in mission planning systems and in-flight moving-map displays. This poster provides an overview of MMC and describes how its development and enhancements are driven by user needs.

Sponsored by the Naval Air Warfare Center-Weapons Division.

Presented at the HCI International 2001 9th International Conference on Human-Computer Interaction, August 5-10,2001, New Orleans, LA.
Naval Research Laboratory Contribution Number NRL/PP/7440--01-1007.
Conference Proceedings
3 Pages

(Olivier)

EFFICIENT STORAGE OF LARGE VOLUME SPATIAL AND TEMPORAL POINT-DATA IN AN OBJECT-ORIENTED DATABASE

Olivier, D. Ladner, R. McCreedy, F. Wilson, R.
Naval Research Laboratory
Stennis Space Center, MS 39529

Abstract

Data mining applications must deal with large volumes of data. In particular, Spatio-Temporal Information Systems must efficiently store and access potentially very large quantities of spatial and temporal data. Therefore, storing the data in an efficient and useful way is of great importance. Binary Large Objects (BLOBs) are found in many database systems and have been extensively used in typical database applications for the storage of large volume data. In this chapter, we describe the extension of basic BLOBs for specialized use with spatial and temporal data. These new repositories, Spatial BLOBs and Temporal BLOBs, add additional functionality for the query and retrieval of the repository's contents in a semantically meaningful, object-oriented form. The repositories are designed as flexible frameworks, decoupled from the particular binary format of their internal contents. Custom plug-ins allow the frameworks to be extended to use a particular binary format that is most appropriate for a given data type.

Key words: spatial data, temporal data, data storage, binary large objects, BLOBs

Sponsored by the Naval Research Laboratory and the Office of Naval Research.

Published in the Kluwer Academic Publishers Book, July 2002.
Naval Research Laboratory Contribution Number NRL/BC/7440--02-1001.
Book Chapter 3, Pages 43-61.

(Petry)

A ROUGH SET FOUNDATION FOR SPATIAL DATA MINING INVOLVING VAGUE REGIONS

Beaubouef, T.
Southeastern Louisiana University
Hammond, LA 70402
Petry, F.
Naval Research Laboratory
Stennis Space Center, MS 39529

Abstract

The RCC and egg-yolk methods have proven useful for representation of vague regions in spatial data. Here we model them using rough set theory. This then develops the basis to allow a rough set approach to uncertainty in spatial relationships for association rules and other forms of spatial data mining.

Sponsored by the Naval Research Laboratory.

Published in the Fuzz IEEE 2002 Proceedings, May 11-16, 2002, Honolulu, Hawaii.
Naval Research Laboratory Contribution Number NRL/PP/7440--02-1002.
Conference Proceedings
6 Pages

(Petry)

FUZZY SPATIAL RELATIONSHIPS AND MOBILE AGENT TECHNOLOGY IN GEOSPATIAL INFORMATION SYSTEMS

Petry, F. Wen, L.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004
Cobb, M. Ali, D. Angryk, R.
Paprzycki, M. Rahimi, S. Yang, H.
University Of Southern Mississippi
Hattiesburg, MS 39406-5106

Abstract

This chapter discusses an integrated work in the definition and implementation of sets of fuzzy spatial relationships concerning topology and direction. We present our basic approach to defining these relationships as an extension to previous work in temporal relations. We also discuss several extensions to this approach that include refinements and alternate definitions. Two implementations are also described, one in a C++, Oracle database environment and another utilizing the expert system shell Fuzzy Clips. Finally we discuss the integration of this querying approach in an agent-based framework. Agent technology has become a leading implementation paradigm for distributed and complex systems, and has recently garnered much interest from researchers in the area of spatial databases. Agents offer many advantages with respect to intelligence abilities and mobility that can provide solutions for issues related to uncertainty in spatial data, such as those of spatial relationships.

Sponsored by the National Imagery and Mapping Agency and the Marine Corps Warfighting Lab.

Published in the Applying Soft Computing In Defining Spatial Relations Book, October 2002.
Naval Research Laboratory Contribution Number NRL/BA/7440--01-1001.
Book Chapter
32 Pages

(Plant)

A SIMPLE MODEL FOR INTERANNUAL SANDBAR BEHAVIOR

Plant, N.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004
Holman, R. Freilich, M.
Oregon State University
Corvallis, Oregon
Birkemeier, W.
U. S. Army Corps of Engineers
Kitty Hawk, North Carolina

Abstract

Time and length scales of beach variability have been quantified using 16 years of beach surveys sampled at the Army Corps of Engineers' Field Research Facility, located on the U.S. Atlantic coast. Between 50% and 90% of the bathymetric variability at this site was explained by alongshore-uniform response over the approximately 1 km alongshore span of the surveys. Although the incident wave height variance was dominated by frequencies at or higher than 1 cycle/yr, more than 80% of the bathymetric variance at all cross-shore locations was explained by frequencies <1 cycle/yr. Interannual cycles consisting of sandbar formation, migration, and decay contributed to the low-frequency variability. The observed behavior can be explained by a simple, heuristic model. The model assumes that bars migrate toward a wave height dependent equilibrium position. This position was shown to coincide with the wave "breakpoint." Additionally, the rate of bar response is taken to be variable and was empirically determined to be proportional to the wave height cubed. The net effect of a variable response rate is to shift the expected long-term mean sandbar position offshore, toward the equilibrium position associated with the largest waves. The model explained up to 80% of the observed bar position time series variance and up to 70% of the variance of bar crest velocity time series, which were extracted from three different sandbars. Characteristic bar response times (related to the inverse of the response rate) were found to be long relative to the characteristic timescale of the forcing (1 year in our case). As a result, transient response (i.e., bar position far from equilibrium) tended to persist for many cycles of the forcing. Transient bar behavior appears in the observations when bars formed near the shoreline or when outer bars decayed and inner bars faced a changed wave climate. While the present model is able to explain the evolution of these transients, it does not contain a mechanism for their introduction.

Sponsored by the University of Twente.

Published in the *Journal of Geophysical Research*, Vol. 104, No. C7, Pages 15,755-15,776, July 15, 1999.
Naval Research Laboratory Contribution Number NRL/JA/7440--02-1001.
Journal Article
22 Pages

(Plant)

ANALYSIS OF THE SCALE OF ERRORS IN NEARSHORE BATHYMETRIC DATA

Plant, N. Holland, K. T. Puleo, J.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

Most studies of nearshore hydrodynamics. sediment transport, and morphology focus on bathymetric variability within a narrow band of spatial and temporal scales. Typically, these studies rely on bathymetry estimates derived from field observations consisting of discrete samples in space and time with varying degrees of measurement error. Sampling limitations, which result in aliasing, and measurement errors can significantly contaminate variability at resolved scales, and may lead to large errors in the representation of the scales of interest. Using a spectral analysis. interpolation errors were analyzed for three different nearshore bathymetric data sets, each of which targeted a different range of spatial scales. Bathymetric features that were unresolved or poorly resolved (e.g., beach cusps) introduced the potential for contamination in two of the data sets. This contamination was significantly reduced using an appropriate scale-controlled interpolation method, leading to more accurate representations of the actual bathymetry. An additional benefit of using scale-controlled interpolation is that interpolation errors may be estimated independently of actual observations, which allows one to design bathymetric sampling strategies that ensure that dominant scales are either resolved or largely removed. Finally, interpolation errors corresponding to a particular sample design can he used to determine which interpolated values contribute usefully to a hand-limited analysis of bathymetric variability.

Sponsored by the Office of Naval Research.

Published in the *Marine Geology Journal,* August 7, 2002.
Naval Research Laboratory Contribution Number NRL/JA/7440--01-1002.
Journal Article (Refereed)
Pages 71-86

(Plant)

ARE N-MINUS-ONE DIMENSIONAL BEACHES PREDICTABLE?

Plant, N. Holland, K. T.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

One of the most attractive and interesting features of beaches is their complexity. An important research objective is to explain the patterns of beach surface variability that may be expressed in both cross-shore and alongshore directions. It is also important to explain how these patterns evolve in time. Many approaches to explaining morphologic variability have focused on reduced-dimensional representations, such as neglecting the variations in one physical dimension. This paper investigates the consequences of neglecting alongshore variability to modeling beach surface evolution.

A coupled hydrodynamic/sediment transport model is investigated that aims to predict changes in the alongshore-uniform component of a beach. Systematic deviations between the model predictions and observed alongshore-averaged profiles may be due to the missing physics associated with the missing dimensionality of the model. This hypothesis is tested by comparing model error to observed alongshore variability, characterized from an alongshore-extensive data set that was obtained from ongoing, long-term field observations at Duck, NC. The results are used to suggest a more consistent modeling approach.

Sponsored by the Office of Naval Research.

Presented at the American Geophysical Union 2002 Fall Meeting, November 19, 2002, San Francisco, CA.
Naval Research Laboratory Contribution Number NRL/AB/7440–02-1003.
Abstract
1 Page

(Plant)

COMPARISON OF BEACH PROFILE EVOLUTION TO PREDICTIONS FROM A NONLINEAR MODEL

Plant, N. Holland, K. T.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

Presently, numerical models can simulate the highly nonlinear hydrodynamic and sediment transport processes that modify the nearshore beach profiles. Because of the inherent nonlinearity of these processes, both natural and simulated profiles are susceptible to instabilities associated with coupled hydrodynamic and morphologic response. These instabilities may generate interesting beach features, such as surf zone sandbars. If instabilities are an important part of the nearshore morphodynamic system, then profile response may be very sensitive to initial conditions, implying that there exist inherent limits to predictability. The details of these limits are largely unexplored.

We compare the predictions of fully nonlinear, process-based, wave-averaged, 1-D-horizontal profile evolution model to a 20-year long data set of observed profile evolution from Duck, NC, USA. The data set allows us to test predictions over evolution times ranging from 1 day up to the full 20 year duration. The objectives of the analysis are to determine the extent to which profile predictions are quantitatively accurate and qualitatively similar to the observations (such as predicting the number or spacing of surf zone sandbars), evaluated over a range of time scales. The analysis will allow us to estimates the prediction horizon associated with this particular data set and profile model and we expect the results to be generally indicative of nearshore morphodynamic systems.

Sponsored by the Office of Naval Research.

Presented at the AGU Meeting, December 10-14, 2001.
Naval Research Laboratory Contribution Number NRL/AB/7440--01-1003.
Abstract
1 Page

(Plant)

EVALUATION OF NEARSHORE PROFILE PREDICTIONS

Plant, N.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

Currently, there are a number of models capable of predicting hydrodynamic and bathymetric evolution across the nearshore profile. These models encompass horizontally 1-dimensional and 2-dimensional evolution. Also, there are a number of hydrodynamic and bathymetric data sets, which span time periods of days [e.g., *Birkemeier and Thornton*, 1994] to decades [e.g., *Wijnberg*, 1995]. Yet, the skill of existing nearshore process models at predicting observed nearshore bathymetric change over a range of time-scales has not been well described.

Sponsored by the Office of Naval Research.

Presented at the International Conference of Coastal Engineers, July 8, 2002, Cardiff, Wales, UK.
Naval Research Laboratory Contribution Number NRL/PP/7440–02-1019.
Conference Proceedings
2 Pages

(Plant)

ROLE OF MORPHOLOGIC FEEDBACK IN SURF ZONE SANDBAR RESPONSE

Plant, N.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004
Freilich, M. Holman, R.
Oregon State University
Corvallis, Oregon

Abstract

Several aspects of feedback mechanisms associated with surf zone sandbar response have been characterized using bathymetric surveys, sampled approximately monthly over a 16-year period at the Army Corps of Engineers' Field Research Facility (North Carolina). The measured bathymetry was alongshore averaged and modeled by the superposition of two Gaussian-shaped sandbars on an underlying planar slope. A third, half-Gaussian-shaped bar represented steepening at the shoreline. The rms error between the measured bathymetry and the profile model was 0.10 m (estimated over 322 different surveys). The model explained 99% of the profile variance that remained after first removing the linear, cross-shore trend from each observed profile. Bar response, which was extracted from the modeled profiles, was compared to a local hydrodynamic forcing variable F (F was defined as the ratio of the wave height to water depth, evaluated at bar crest locations). At low values of F (i.e., nonbreaking conditions), bars migrated onshore, and their amplitude tended to decay. At high values of F (i.e., breaking conditions), bars migrated offshore, with relatively little change in amplitude. The transition between onshore and offshore migration occurred at a value of F that was consistent with the onset of wave breaking. Bar migration was associated with a stabilizing feedback mechanism, which drove bar crests toward an equilibrium position at the wave breakpoint. However, we observed that the rate of bar response showed no reduction for any nonzero choice of F, indicating that bars never reached equilibrium. Systematic bar amplitude decay was observed under nonbreaking conditions. Bar amplitude decay could drive F farther away from breaking conditions, allowing further bar amplitude decay. This is a destabilizing feedback mechanism, potentially leading to bar destruction.

Sponsored by the University of Twente.

Published in the *Journal of Geophysical Research*, Vol. 106, No. C1, Pages 973-989, January 15, 2001.
Naval Research Laboratory Contribution Number NRL/JA/7440--02-1002.
Journal Article
17 Pages

(Puleo)

A COMPARISON OF REMOTE SENSING AND IN SITU MEASUREMENTS OF NEARSHORE FLOWS

Puleo, J. Holland, K. T.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004
Farquharson, G. Frasier, S. J.
University of Massachusetts
Amherst, MA 01003
Raubenheimer, B.
Woods Hole Oceanographic Institution
Woods Hole, MA 02543

Abstract

During October 2000, a surf zone field experiment was conducted at Scripps Beach in La Jolla, CA with one objective being the validation of 2 remote sensing techniques for measuring nearshore flows. Wave propagation speeds and surface flow velocities were estimated over a roughly 50 by 250 m study area using particle image velocimetry (PIV) (based on time sequence imagery of surface foam patterns) and radar techniques (based on the Doppler shift of a signal reflected off the water surface). Simultaneous near bottom measurements of the horizontal flow field were also obtained at 6 cross-shore locations spanning the surf and swash zones using acoustic Doppler velocimeters (ADV) (based on the Doppler shift of a signal reflected off particulate matter within the water column). Preliminary comparisons in the surf zone show that the radar and PIV measurements are highly correlated and have similar spectral characteristics. In the swash zone, PIV and ADV measurements were similar during the uprush, however, backwash flows on this beach were difficult to measure with the PIV technique due to a lack of surface texture resulting from the absence of foam or bubbles. We found that by adjusting the search algorithm, PIV can be used to estimate either wave propagation speeds (similar to those measured with radar) or surface flow velocities (similar to those measured with the ADV) to give a flexible remote sensing method. Comparisons of measurements made using the three techniques as well temporally averaged flow patterns will be presented.

Sponsored by the Office of Naval Research.

Presented at the AGU Meeting, December 10-14, 2001, San Francisco, CA.
Naval Research Laboratory Contribution Number NRL/AB/7440–01-1004.
Abstract
1 Page

(Puleo)

A VIDEO-BASED PARTICLE IMAGE VELOCIMETRY (PIV) TECHNIQUE FOR NEARSHORE FLOWS

Puleo, J. Holland, K. T. Kooney, T.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

The measurement and prediction of nearshore (littoral) currents is important scientifically, societally and militarily. Nearshore physical processes such as beach erosion are largely forced by current magnitudes and can affect military operations including amphibious landing and mine burial. Because of cost and logistic difficulty in placing instruments in the dynamic nearshore, *in situ* deployments tend to be extremely sparse. Yet, flows in this region are typically very complex and non-uniform in space and time requiring a dense measurement scheme to accurately record flow phenomena. Recently, a cost-effective, spatially dense, remote sensing video technique (based on particle image velocimetry), using correlation of sequential snapshots of surface foam patterns was developed at the Naval Research Laboratory to quantify nearshore currents. Unlike sparse sampling using traditional *in situ* instrumentation, the technique yields thousands of estimates of surface velocities (at 2.5 Hz) and should improve our understanding of nearshore flows. Results from 2 field experiments will demonstrate the utility and validity of this method.

Sponsored by the Naval Research Laboratory.

Published in the *Naval Research Laboratory 2001 Review,* April 2001.
Journal Article
Pages 162-164

(Puleo)

A VOLUME OF FLUID MODEL FOR SURF AND SWASH ZONES

Puleo, J. Holland, K. T.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004
Slinn, D. Webb, B.
University of Florida
Gainesville, FL 32611-6590

Abstract

Numerical modeling of nearshore waves and currents is necessary for forecasting hydrodynamic conditions and sediment transport which are used to predict erosion and accretion patterns of the nearshore profile. A typically used hydrodynamic model can be derived from the one-dimensional depth averaged non-linear shallow water equations (NLSWE). While this formulation has been shown to match field and laboratory data well, simplifications in the governing equations restrict the applicability of the model. For instance, the shallow water assumption means that separate models are required to shoal waves from deep water through the swash zone. Further, the depth-averaged nature yields no information regarding the vertical velocity profile and the boundary layer structure, which can be used to estimate the time dependent bed shear stress needed for sediment transport formulations. To overcome some of the drawbacks to the depth-averaged NLSWE, a 2D (x,z) volume of fluid model derived from the full Navier-Stokes equations has been modified for predicting sea surface elevations and depth dependent fluid velocities across the surf and swash zones. The volume of fluid approach discretizes the model domain into individual fluid volumes and calculates the appropriate force balances in each control volume and the flux of water across each control surface. Comparisons to laboratory data collected in a wave basin show excellent predictive skill for the sea surface elevations, while prediction of cross-shore fluid velocities suffers from over-prediction during the passage of broken waves. Model/data comparisons and model development including an upgrade from a constant eddy viscosity to a 2 equation turbulence closure scheme will be discussed.

Sponsored by the Office of Naval Research.

Presented at the American Geophysical Union 2002 Fall Meeting, November 19, 2002, San Francisco, CA.
Naval Research Laboratory Contribution Number NRL/AB/7440–02-1002.
Abstract
1 Page

(Puleo)

ESTIMATING SWASH ZONE FRICTION COEFFICIENTS ON A SANDY BEACH

Puleo, J. Holland, K. T.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

Video based swash motions from three studies (on 2 separate beaches) were analyzed with respect to theoretical swash trajectories assuming plane beach ballistic motions under quadratic friction. Friction coefficient estimates for both the uprush and backwash were estimated by comparing measured swash space-time trajectories to theoretical trajectories. Observations were made spanning high tides and in one case during a light rain. Analysis of over 4500 individual swash events showed the uprush friction coefficient was nearly constant during all three studies with a mean value of roughly 0.01, which is close to the theoretical estimate based on a Law of the Wall formulation and is a commonly referenced value in the literature. Backwash friction coefficient values varied over the tidal cycle between 0.01 and 0.07 with minimum values corresponding to the highest tides. Increased frictional values in the backwash are attributed to the lack of a pressure gradient term in the simple ballistic model. Accounting for this pressure gradient effect suggests backwash friction coefficients are approximately equal to the uprush friction value at high tide and may be as large as 3 times the uprush friction value during low tides. This tidal dependence for backwash friction coefficients is attributed to a complex interaction between swash infiltration and entrained sediment loads. These findings imply that friction estimates (necessary for sediment transport calculations and hydrodynamic predictions) based solely on grain roughness may not be correct for backwash flows.

Sponsored by the Office of Naval Research through base funding to the Naval Research Laboratory Program Element Number 61153N.

Published in the *Coastal Engineering,* April 2000, Volume 43 (1): Pages 25-40.
Naval Research Laboratory Contribution Number NRL/JA/7442—00-0009.
Journal Article (Refereed)

(Puleo)

FIELD OBSERVATIONS OF THREE-DIMENSIONAL SWASH ZONE FLOW PATTERNS AND MORPHODYNAMICS

Puleo, J. Holland, K. T.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004
Sallenger, A.
USGS
St. Petersburg, FL

Abstract

Morphologic changes on the beach face occur as a direct result of swash zone processes. Although it is accepted that these processes are responsible for the large nearshore sediment fluxes, understanding the mechanisms by which the sediment fluxes occur has, for the most part, been unsuccessful. Descriptions of swash motions and sediment transport are hampered by the complexity, nonlinearity and feedback that exists between fluid motions and underlying bathymetry. Therefore, even though the importance of the swash zone is noted, it is not surprising that it remains to be one of the more poorly understood regions of the nearshore.

Previous swash zone studies have analyzed morphodynamics, flow patterns and sediment transport using coarsely sampled data in space and/or time. One method employs a grid of sampled bed elevation changes to determine morphologic evolution and infer total load sediment transport rates [e.g.; Sallenger and Richmond 1984]. A second method involves recording sediment concentrations and velocities at several locations to estimate the transport gradients which lead to an estimate of morphologic evolution [e.g.; Puleo et al., submitted; Beach et al., 1993]. These measurements have assisted in interpreting and predicting swash zone phenomena, however the lack of densely sampled temporal and spatial hydrodynamic and morphologic data has made development and testing of morphodynamic models for beach change difficult. Furthermore, sampling designs from these previous studies generally yields only 2-dimensional (2D; x,z) data sets. Yet, it is known that many beaches display non-uniform longshore morphology. Hence, spatially and temporally dense 3-dimensional (3D) hydrodynamic and morphologic data are needed to more accurately test morphodynamic models of foreshore evolution.

Sponsored by the Office of Naval Research.

Published at the Coastal Engineering Conference, July 2000, Sydney, Australia.
Naval Research Laboratory Contribution Number NRL/PP/7442–00-0001.
Conference Proceedings
Pages 637-650

(Puleo)

LITTORAL DYNAMICS TEAM

Puleo, J. Holland, K. T. Plant, N.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

The littoral dynamics team performs basic and applied research on hydrodynamics, sediment transport and morphological change within the surf and swash zones. Our goal is to develop predictive capabilities for fluid motions (waves and currents) and sediment transport leading to refined models for morphologic change (e.g. beach face erosion/accretion or sand bar growth/migration). The techniques that enable us to learn about these processes (e.g. video-based motion imagery systems, algorithms, and numerical models) can then be transitioned for military relevant applications and eventually assist the warfighter in forecasting nearshore environmental changes that affect his ability to perform littoral and amphibious maneuvers.

Sponsored by Naval Research Laboratory.

Published as a Naval Research Laboratory Web Page, August 23, 2002.
Naval Research Laboratory Contribution Number NRL/WP/7440–02-1001.
NRL Web Page
118 Pages

(Puleo)

NUMERICAL MODELLING OF SWASH ZONE HYDRODYNAMICS

Puleo, J. Holland, K. T.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004
Slinn, D.
University of Florida
Gainesville, FL 32611-6590

Abstract

The swash zone is the area of the nearshore that is intermittently covered and uncovered by wave run-up. Since swash hydrodynamics control the evolution of beach morphology, understanding these motions is of paramount importance. Typical studies of swash zone hydrodynamics involve the deployment of several instruments (current meters, e.g. Puleo *et al.*, 2000; Doppler devices, e.g. Petti and Longo, 2001; among other methods) to measure the swash zone fluid velocity. While the Doppler devices have the ability to readily distinguish vertical flow structure, instrument deployment is necessarily sparse due to cost and logistics. Recently a video-based remote sensing technique has also been developed that is capable of quantifying surface swash velocities over a fairly large spatial domain, but yields no information regarding subsurface flows (Holland *et al.*, 2001).

Another possibility for understanding swash hydrodynamics is through numerical simulations. A two dimensional (2D) numerical model, RBREAK (Wurjanto and Kobayashi, 1991), based on the viscid non-linear depth-averaged shallow water equations accurately models observations (Raubenheimer *et al.*, 1995; van der Meer and Breteler, 1990). But, the depth-averaged nature limits the information (no quantification of shear stresses, vorticity etc.) gleaned from the model. However, Slinn *et al.* (2000), have utilized an existing 2D depth-dependent model, RIPPLE (Kothe *et al.*, 1991), for simulating swash zone hydrodynamics. The RIPPLE model will be investigated here, specifically in comparison to laboratory observations.

Sponsored by the Office of Naval Research.

Presented at the International Conference of Coastal Engineers, July 8, 2002, Cardiff, Wales, UK.
Naval Research Laboratory Contribution Number NRL/PP/7440–02-1018.
Conference Proceedings
3 Pages

(Puleo)

VALIDATION OF A PARTICLE IMAGE VELOCIMETRY TECHNIQUE FOR NEARSHORE FLOWS

Puleo, J. Holland. K. T. Kooney, T.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

The swash zone, the foreshore area of beach directly affected by wave runup, experiences complex fluid motions and associated sediment transport. Therefore, one key to understanding foreshore sediment transport involves accurately describing the velocity field in this region. Yet the interesting and scientifically relevant aspects of the swash zone fluid dynamics, such as: rapid flows, large accelerations, velocity skewness, backwash/uprush collisions, alongshore non-uniformity and very shallow depths, can themselves be prohibitive to measuring and accurately describing the swash and very nearshore flow field. For example, ducted-impellor current meter, acoustic Doppler Velocimeter (ADV) and electro-magnetic current meter (EM) signals are all adversely affected by aperiodic immersion and emergenge (also ADV signals may be affected by bubbles and EM signals by proximity to bed). Furthermore, instrument deployment is typically very sparse. Therefore, the need exists for spatially and temporally dense velocity estimates in this harsh and complex environment.

Recently, two-dimensional (2D) video-based particle image velocimetry (PIV) has been applied to the nearshore region and compared favorably to other video-based horizontal velocity estimations (timestack method) in the swash zone. PIV is appealing because it is a non-intrusive, cost-effective method yielding dense 2D horizontal surface velocity estimates over a large spatial region. This study aims to further validate the PIV technique through a field experiment conducted at Scripps Beach in La Jolla, CA by comparing PIV surface velocity vectors with those obtained from the timestack method and several ADV's deployed across the swash zone. Swash flow time series and temporally averaged swash flow patterns over a roughly 20 x 40 m spatial area will also be presented.

Sponsored by the Office of Naval Research.

Published at the AGU Fall Meeting, December 2000, San Francisco, CA.
Naval Research Laboratory Contribution Number NRL/AB/7440-00-0016.
Abstract

(Sample)

PROGRESS UPDATE FOR THE SEDIMAP PROJECT

Sample, J. Bentrem, F.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

Task Status Summary

1. Test Sedimap with raw data from Dry Tortugas
   - 90% complete
2. Evaluate Simrad preprocessed data for use in Sedimap
   - 90% complete
3. Evaluate inversion sensitivity to noise and coverage
   - 80% complete

Sponsored by SPAWAR.

Presented to NAVOCEANO, June 14, 2002, Stennis Space Center, MS.
Naval Research Laboratory Contribution Number NRL/OP/7440—02-1012.
Oral Presentation
14 Pages

(Shaw)

A CLIPS-BASED IMPLEMENTATION FOR QUERYING BINARY SPATIAL RELATIONSHIPS

Yang, H. Cobb, M.
University of Southern Mississippi
Hattiesburg, MS 39401-5601
Shaw, K.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

The power of spatial queries for analysis and planning purposes in many different application fields has drawn significant attention within the GIS research field. The extraction of meaningful information from spatial data requires specialized data structures, query languages and query processing strategies.

This paper is primarily concerned with the binary data structures that support the fuzzy queries of spatial relationships in two dimensions. For implementation purpose, the topological relations in this model are refined from a previously defined model. This modified binary spatial model will reduce the burden of geometric computation. Based on the modified binary spatial model, a CLIPS implementation for querying binary spatial relationships is investigated. Details about the query processing strategies are also provided.

Sponsored by Marine Corps Warfighting Lab.

Presented at the North American Fuzzy Information Processing Society 2001 Conference, July 25-28, 2001, Vancouver, Canada.
Naval Research Laboratory Contribution Number NRL/PP/7440—01-1003.
Conference Proceedings

(Shaw)

A SMART POINTER FOR A DISTRIBUTED SPATIAL DATABASE

Karam, O. Petry, F.
Tulane University
New Orleans, LA
Shaw, K.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

We are developing a distributed Object oriented spatial database prototype. We are extending the GIDB prototype (developed at NRL for using and querying OVPF databases) to support distribution. The GIDB is a Geographical information System coupled with an object-oriented spatial database, which is implemented using the GemStone Object Database. We are currently exploring alternatives to add distribution to the prototype.

We tried GemEnterprise as our distributed OODB, but needed to add a different model of distribution to it. In order to do so, we used a smart painter technique, taking advantage of the dynamic capabilities of the SmallTalk language.

Also, we did several experiments comparing performance of returning a 'smart pointer' from a remote method, or returning a copy of the remote object. The 'smart pointer' usually is smaller, so the transmission cost is smaller, but future messages have to be done remotely instead of locally.

Sponsored by Marine Corps Warfighting Lab.

Presented at the 13th International Conference on Industrial/Engineering Applications of Artificial Intelligence & Expert Systems, June 19-22, 2000, New Orleans, LA.
Naval Research Laboratory Contribution Number NRL/PP/7441—00-0002.
Conference Proceedings

(Shaw)

FUZZY SPATIAL QUERYING WITH INEXACT INFERENCE

Yang, H. Cobb, M. Ali, D. Rahimi, S.
University of Southern Mississippi
Hattiesburg, MS 39406
Petry, F.
Tulane University
New Orleans, LA
Shaw, K.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

The issue of spatial database accuracy has been viewed as critical to the successful implementation and long-term viability of the geographic information system (GIS) technology. In order to improve the spatial querying accuracy and quality, the problems associated with the areas of fuzziness and uncertainty are of great common in the spatial databases. In this paper, we are dedicated to develop an approach that can perform fuzzy spatial querying under uncertainty. An inferring strategy under uncertainty is investigated. The study shows that the fuzzy set and the certainty factor can work together to deal with spatial querying. Querying examples implemented by FuzzyClips are also provided.

Sponsored by the Office of Naval Research.

Presented at the North American Fuzzy Information Processing Society 2002 Conference, June 2002, New Orleans, LA.
Naval Research Laboratory Contribution Number NRL/PP/7440—02-1012.
Conference Proceedings (Refereed)
Pages 377-382

(Shaw)

THE 2-3TR-TREE, A TRAJECTORY-ORIENTED INDEX STRUCTURE FOR FULLY EVOLVING VALID-TIME SPATIO-TEMPORAL DATASETS

Givaudan, J. Abdelguerfi, M.
University of New Orleans
New Orleans, LA
Shaw, K. Ladner, R.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

Supporting large volumes of multi-dimensional data is an inherent characteristic of modern database applications, such as Geographical Information Systems (GIS), Computer Aided design (CAD), and Image and Multimedia Databases. Such databases need underlying systems with extended features like query languages, data models, and indexing methods, as compared to traditional databases, mainly because of the complexity of representing and retrieving data. The presented work deals with access methods for databases that accurately model the real world. More precisely, the focus is on index structures that can capture the time varying nature of moving objects, namely spatio-temporal structures. A new taxonomy to classify these structures has been defined according to dataset characteristics and query requirements. Then, a new spatio-temporal access method, the 2-3TR-tree, has been designed to process specific datasets and fulfill specific query requirements that no other existing spatio-temporal index could handle.

Key Words – Spatio-temporal, indexing, R-tree, Taxonomy.

Sponsored by the Office of Naval Research and the Naval Research Laboratory.

Presented at the ACM GIS Conference, September 1, 2002, New Orleans, LA.
Naval Research Laboratory Contribution Number NRL/PP/7440—02-1015.
Conference Proceedings
20 Pages

(Shaw)

UNCERTAINTY IN DISTRIBUTED AND INTEROPERABLE SPATIAL INFORMATION SYSTEMS

Cobb, M.
University of Southern Mississippi
Hattiesburg, MS 39406
Foley, H.
Xavier University
New Orleans, LA 70125
Petry, F.
Tulane University
New Orleans, LA
Shaw, K.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

Many facets of spatial data representation inherently involve issues of accuracy and uncertainty. This problem is greatly magnified when considering the integration of spatial data from different sources, such as in a distributed or interoperable environment. The general concept of schema merging involves the resolution of incompatibilities as in a distributed environment. These may be either structural or semantic in nature. Structural incompatibilities involve those, for example, in which attributes for representing the same values are defined differently. Semantic incompatibilities, however, represent those cases in which similarly defined attributes have different meanings or values. For example, an attribute of WIDTH for a road in one database may include the width of associated access lanes, while in another database it may be only the main drivable portion of the road. Such semantic issues are much more difficult to resolve, as they require a deeper understanding of the data. We will survey the issues as discussed above for spatial data in such environments and describe several approaches for different aspects of the data using fuzzy set techniques to deal with the incompatibilities.

Sponsored by the Marine Corps Warfighting Lab.

Published in the Recent Issues On Fuzzy Databases book, December 2000.
Book Chapter

(Steed)

A FLAT-EARTH STORAGE SYSTEM FOR DBDB-V

Steed, C.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004
Braud, J.
Naval Oceanographic Office
Stennis Space Center, MS 39529-5004

Abstract

The Naval Oceanographic Office's (NAVOCEANO) Digital Bathymetric Data Base – Variable resolution (DBDB-V) file model must be expanded to support the storage of large-scale datasets acquired from Through-The-Sensors (TTS) architectures such as the Precision Underwater MApping system (PUMA). Although the current DBDB-V model works well for the traditional resolutions supported by DBDB-V, the incorporation of Universal Transverse Mercator (UTM) and Universal Polar Stereographic (UPS) storage capabilities is needed to accommodate high-resolution datasets. Based on the principles of the Military Grid Reference System (MGRS), a system is proposed that makes use of UTM and UPS to provide global, tiled data coverage for horizontal resolutions down to 1-meter. The system provides the flexibility to extend extracted grids beyond normal zones and system boundaries. Similarly, the system supports flexible grid ingest by allowing input grids to extend beyond the normal limits of zone or system boundaries. The UTM and UPS storage system provides a global flat-earth view of bathymetric data that meets the demands of large-scale TTS datasets.

Sponsored by the Oceanographer of the Navy via SPAWAR PMW155.

Published as NRL/FR/7440—02-10,025, August 13, 2002.
Formal Report
12 Pages

(Steed)

A METHOD FOR OVERCOMING DISCONTINUITY BETWEEN NEIGHBORING UTM ZONE GRIDS

Steed, C.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

The Universal Transverse Mercator (UTM) projection is ideally suited for use with large-scale geographic data. The Naval Research Laboratory at Stennis Space Center (NRLSSC) has investigated the UTM projection in support of the Naval Air Systems Command. In the investigation of the UTM grid, the properties and construction of the UTM projection have been analyzed to identify advantages and disadvantages in the system. A major disadvantage of the system is the lack of continuity between neighboring UTM zone grids. This problem is most apparent when dealing with an area of interest that spans multiple UTM zones. To alleviate this problem, the concept of flexible zone boundaries for UTM zones has been developed and applied to two specific situations in UTM area of interest processing. The first situation involves the creation of a single UTM grid from the grids of neighboring UTM zones in a defined area of interest. The second is the extraction of native UTM zone grids from a single UTM grid that spans multiple UTM zones.

Sponsored by the Naval Air Systems Command.

Presented as NRL/AB/7440—01-1006, February 21-22, 2002 at the Mississippi Academy of Sciences Annual Meeting, Biloxi, MS.
Abstract
1 Page

(Steed)

OVERCOMING DISCONTINUITY BETWEEN UTM ZONE

Steed, C. Mesick, H.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

UTM Properties

- Developed by National Imaging and Mapping Agency (NIMA)
- Transverse Mercator Projection (Gauss-Kruger type) in zones 6^0 wide
- 60 zones where Central Meridians are at 3^0, 9^0, 15^0, 27^0, ..., 177^0 (east and west)
- Latitude of Origin is 0^0 (the Equator)
- Latitude Limits are from 80^0S to 84^0N

Sponsored by the Naval Air Systems Command.

Presented as NRL/OP/7440—02-1003, February 20-22, 2002 at the Mississippi Academy of Sciences Annual Meeting, Biloxi, MS.
Oral Presentation
15 Pages

(Steed)

PUMA/TEDS TECHNICAL EXECUTION PLAN

Steed, C. Landrum, J.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004
Moreau, C.
Anteon Corporation
San Diego, CA

Abstract

This report describes the plans for the assimilation of bathymetric data collected by PUMA systems using TEDS and DBDB-V. As a Through the Sensors project, the system is designed to exploit the battle space environment in near real-time using tactical sensors to support tactical decision aids, models, and dynamic databases. Three levels of near real-time tactical decision support are defined through a DBDB-V supplementary partition as well as periodic DBDB-V upgrades. To support the collection and assimilation of PUMA data, a new grid file format is proposed with merge, ingest, and extraction capabilities for dynamic sensor data and historical DBDB-V data. Data flow scenarios for the system provide local, regional, and global assimilation, as well as historical DBDB-V upgrades. Software upgrades are defined for the DBDB-V, TEDS, and NAVOCEANO components of the system. The software required for the system will be developed in a generic fashion to support the data types of future Through the Sensor developments.

Sponsored by the Oceanographer of the Navy via SPAWAR PMW 155.

Published as NRL/FR/7440—02-10,003, June 13, 2002.
Formal Report
32 Pages

(Steed)

VGRID: A GENERIC, DYNAMIC HDF5 STORAGE MODEL FOR GEOREFERENCED, GRID DATA

Steed, C.
Naval Research Laboratory
Stennis Space Center, MS 39529
Braud, J.
Naval Oceanographic Office
Stennis Space Center, MS 39529
Koehler, K.
Space and Naval Warfare Center
San Diego, CA 92110

Abstract

This paper describes the Variable GRID (VGRID) storage model designed to support the storage and retrieval of bathymetric data collected through the Precision Underwater MApping (PUMA) System using the Tactical Environmental Data Server (TEDS) and the Naval Oceanographic Office's (NAVOCEANO) Digital Bathymetric Data Base – Variable (DBDB-V) Resolution product. Sponsored by the Space and Naval Warfare Systems Command (SPAWAR, PMW-155), PUMA-TEDS represents a significant advancement in the collection and assimilation of environmental data at global, regional or local levels. Although VGRID has been developed for PUMA bathymetry, its generic implementation makes it suitable for use with any type of environmental data grid through the definition of a product specification.

Built on NCSA's Hierarchical Data Format version 5 (HDF5), the VGRID model inherits the HDF5 file format and library implementation that is optimized for large-scale scientific data storage. The VGRID model provides a hierarchy of environmental storage objects: files, layers, and grids. A VGRID file can contain VGRID layers enabling multi-layered data storage. VGRID layers can contain VGRID resolution (grid) groups that are based on geographic minutes, meters, or polar stereographic grid increments. The resolution interface supports the storage of geographic, polar stereographic, Universal Transverse Mercator (UTM), and Universal Polar Stereographic (UPS) projected grids. Behind the scenes of the VGRID API, a tile scheme is applied to data written to the VGRID file. When VGRID resolutions are created, compression options can be set for all tiles created in the resolution. The VGRID tile scheme provides the framework for a robust tile caching mechanism, which minimizes the time required to read data from a VGRID file.

The VGRID API uses a "bounce" algorithm to search each resolution and extract the highest resolution data for a VGRID point query. In addition, three interpolation options are available for point queries: nearest neighbor, bilinear, and minimum curvature spline. The minimum curvature spline algorithm provides a "feathering" capability that effectively reduces the artifacts that often occur at the resolution boundaries of multiple resolution datasets.

To support the dynamic nature of the PUMA-TEDS system, the concept of co-existing supplemental and historical VGRID files has been developed to support enhancements to the principle database product. To preserve the generic storage model, the supplementary file concept is not included in the VGRID specification but is left for implementation at the product specification level. Investigation of the PUMA-TEDS DBDB-V model provides valuable insight into the dynamic possibilities of the VGRID file model.
Sponsored by SPAWAR PMW 155.

Presented at the Oceans 2002 Conference & Exhibition, October 29-31, 2002, Biloxi, MS.
Naval Research Laboratory Contribution Number NRL/PP/7440—02-1003.
Conference Proceedings
7 Pages

(Trenchard)

A TWO-PART STUDY ON THE USE OF BATHYMETRIC AND NAUTICAL MAPPING INFORMATION IN A MOVING MAP DISPLAY TO SUPPORT MINE COUNTER MEASURES OPERATIONS

Trenchard, M. Lohrenz, M. Myrick, S. Gendron, M.
Naval Research Laboratory
Stennis Space Center, MS 39529

Abstract

Cockpit moving map displays have been employed in the tactical air community for several years to support air-to-air and air-to-ground missions and have been shown to be excellent situational awareness (SA) tools. This study examines the potential of using the next-generation cockpit moving map display to support the difficult Mine Counter Measures (MCM) and Mine Sweeping Operations. Specifically, the Naval Research Laboratory - Stennis Space Center (NRLSSC) will leverage the Naval Air Systems Command's Tactical Aircraft Moving Map Capability (TAMMAC) digital moving map system as a demonstration platform to incorporate bathymetric and nautical map data designed to support in-flight MCM operations. Of critical importance to this project is a two-part human factors study to 1) determine MCM helicopter aircrew preferences from the various types of map data under consideration, and 2) measure and evaluate aircrew performance both with and without the moving map capability. This study is being conducted as part of NRLSSC's Generation and Exploitation of Common Environment (GECE) project that will support MCM and amphibious operations in Fleet Battle Experiment - India (FBE-I) or Kernal Blitz 2001 (KB '01).

Sponsored by the Naval Research Laboratory and the Office of Naval Research.

Presented at the Human Performance, Situation Awareness and Automation: User-Centered Design for the New Millennium, October 15-19, 2000, Savannah, GA.
Naval Research Laboratory Contribution Number NRL/PP/7440—00-0013.
Conference Proceedings (Refereed)

(Trenchard)

CRITICAL ISSUES CONCERNING DIGITAL MAP PROCESSING FOR THE AN/ASQ-196 DIGITAL MAP SYSTEM

Trenchard, M. Lohrenz, M.
Naval Research Laboratory
Stennis Space Center, MS 39529

Abstract

F/A-18 and AV-8B naval aircraft in the U.S. and abroad use an aging digital moving-map system that will be replaced by the TAMMAC system over the next 10 years. Until this transition is complete, care must be taken to balance two important goals:

(1) Guarantee the continued availability of media (i.e., AODs) to support the legacy map systems.
(2) Ensure flight safety by maintaining an up-to-date map (i.e., CAC) database.

In order to meet these goals, NRL recommends performing a detailed analysis of existing AODs (including the currency of the CAC data contained therein), future AOD requirements (as outlined in this report), currently available CAC data, and DCHUM releases to define a realistic and appropriate update schedule for the AODs and supporting CAC database.

Sponsored by the Naval Air Systems Command AV-8B and F/A-18 programs, Program Elements 0604214N and APN.

Published as a Naval Research Laboratory Formal Report, January 7, 2000.
Naval Research Laboratory Contribution Number NRL/FR/7440—00-9942.
NRL Formal Report

(Trenchard)

EVALUATION AND COMPARISON OF GOTS DIGITAL MAPPING SOFTWARE TO SUPPORT HIGH RESOLUTION DIGITAL MAPPING FOR PRECISE LANE NAVIGATION ON AMPHIBIOUS ASSAULT VEHICLES

Trenchard, M. Gendron, M. Edwards, S. Myrick, S.
Naval Research Laboratory
Stennis Space Center, MS 39529

Abstract

The Naval Research Laboratory (NRL) has been tasked by the Office of Naval Research to investigate and provide low-cost COTS (Commercial-off-the-shelf) and GOTS (Government-off-the-shelf) moving-map hardware and software packages to improve lane navigation for amphibious vehicles such as the LCAC (Landing Craft Air Cushion), LCU (Landing Craft Utility), and the AAV (Amphibious Assault Vehicle). The hardware systems will use differential GPS and standard Intel computers running the Windows operating system. NRL is evaluating two Windows-based GOTS digital mapping software packages for amphibious lane navigation. One program is the Command and Control PC (C&PC version 5.6.3) developed by the Inter-National Research Institute and the other one is the Falconview map display software of the Portable Flight Planning System (PFPS) developed by Georgia Tech Research Institute. Both of these software packages have the ability to accept differential GPS data strings and provide a "moving-map" display. In addition, both software packages have the ability to read National Imagery and Mapping Agency (NIMA) standard raster (Raster Product Format) and vector (Vector Product Format) map data. For amphibious navigation, very high-resolution geospatial information is also imported and displayed via geotiff files. A series of exercises on the LCAC, LCU, and AAV will be conducted during the summer of 2002 as part of the Fleet Battle Experiment - Juliet (FBE-J) to demonstrate precise lane navigation using these software packages hosted on the COTS hardware. In addition, NRL is collaborating with the Coastal Systems Station (CSS) in Panama City during the demonstration. CSS has been funded by N75 to conduct a lane width study. While digital moving map technology is in wide use in the Naval and Marine Corps aviation community, the results of this study will help to further advance the concept of low-cost digital moving map technology in navigation for amphibious vehicles.

Sponsored by the Office of Naval Research.

Presented at the Oceans 2002 Conference & Exhibition, October 29-31, 2002, Biloxi, MS.
Naval Research Laboratory Contribution Number NRL/PP/7440—02-1014.
Conference Proceedings
1 Page

(Trenchard)

FAF MOVING-MAP COMPOSER PHASE I PROGRAM REVIEW

Trenchard, M. Myrick, S.
Naval Research Laboratory
Stennis Space Center, MS 39529

Abstract

FAF MMC Phase I Objective

Provide a Moving Map Composer System to the Finland F/A-18 Program with customized software development for FAF-specific needs.

Sponsored by the Naval Air Warfare Center.

Presented to the Finland Air Force, May 24, 2002, Stennis Space Center, MS.
Naval Research Laboratory Contribution Number NRL/OP/7440—02-1009.
Oral Presentation
41 Pages

(Trenchard)

MAP REQUIREMENTS CROSSWALK FROM MMC TO PFPS / JMPS

Trenchard, M. Lohrenz, M.
Naval Research Laboratory
Stennis Space Center, MS 39529

Abstract

The Naval Research Laboratory (NRL) Code 7440.1 developed the Moving Map Composer (MMC) software in support of the AV-8B Mission Support System (MSS) (Lohrenz, et al., 1998). The AV-8B program plans to transition its MSSIMMC functionalities to the Portable Flight Planning System (PFPS) in conjunction with replacing its old AN/ASQ-196 Digital Moving-Map Systems (DMS) with new Tactical Aircraft Moving-Map Capability (TAMMAC) systems.

In preparation for these transitions, the AV-8B program tasked NRL with identifying any AV-8B-unique MSS/MMC features that must be incorporated into the PFPS system to maintain full AV-8B functionality. To that end, NRL compared MMC version 3.3 with the FalconView (version 3.1) portion of the Portable Flight Planning System (PFPS).

Sponsored by the Naval Air Warfare Center.

Published as a Naval Research Laboratory Memorandum Report, March 20, 2000.
Naval Research Laboratory Contribution Number NRL/MR/7440—00-8238.
NRL Memorandum Report

(Trenchard)

MOVING-MAP COMPOSERS SYSTEM VERSION 3.4P ACCEPTANCE TEST PROCEDURES

Trenchard, M. Lohrenz, M. Gendron, M. Myrick, S.
Naval Research Laboratory
Stennis Space Center, MS 39529

Abstract

This document provides detailed Acceptance Test Procedures (ATP) to be followed during the final test and evaluation of the Naval Research Laboratory (NRL) Moving-Map Composer (MMC) version 3.4P software, developed for the Finland Air Force (FAF). The ATP will be performed on a FAF-owned Digital Alpha computer, currently located at NRL, during the Test Readiness Review (TRR) #1 and during installation and training in Finland.

Sponsored by the Naval Air Warfare Center.

Published as a Naval Research Laboratory Memorandum Report, July 29, 2002.
Naval Research Laboratory Contribution Number NRL/MR/7440—02-8279.
NRL Memorandum Report
29 Pages

(Trenchard)

TAMMAC APPLICATION OF NIMA GEOSPATIAL INFORMATION

Trenchard, M.
Naval Research Laboratory
Stennis Space Center, MS 39529

Abstract

To familiarize TAMMAC customers with the application and acquisition of current and future geospatial information provided by the National Imagery and Mapping Agency (NIMA) supported in TAMMAC.

Sponsored by the Naval Air Warfare Center.

Presented to the PMA 209 Users Conference, February 7, 2002, San Diego, CA.
Naval Research Laboratory Contribution Number NRL/OP/7440—02-1001.
Oral Presentation
38 Pages

(Trenchard)

TAMMAC USE OF NIMA GEOSPATIAL PRODUCTS

Trenchard, M.
Naval Research Laboratory
Stennis Space Center, MS 39529
Waring, LCDR
NAVAIR
Patuxent River, MD

Abstract

To familiarize TAMMAC customers with the application and acquisition of current and future geospatial information provided by the National Imagery and Mapping Agency (NIMA) supported in TAMMAC.

Sponsored by TAMMAC.

Presented at the TAMMAC User's Group Conference, February 5-9, 2001.
Naval Research Laboratory Contribution Number NRL/OP/7440—01-1002.
Oral Presentation

(Wilson)

DESIGNS AND LESSONS LEARNED IN OBJECT-ORIENTED WEB-BASED MAPPING

Wilson, R. McCreedy, F. Ladner, R.
Chung, M. Shaw, K.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

This paper presents a summary of designs used in developing an object-oriented web-based mapping application. The Web Mapping Toolkit (WMT) is a Java applet which accesses mapping data from the Geospatial Information Database (GIDB). The GIDB is an object-oriented database developed by the Naval Research Laboratory which stores multiple data types from many sources. The motivation for development of the WMT is to allow users to access geographical data over the Internet through a web browser, without the necessity of specialized software or hardware. Main topics of discussion for the design of the WMT will include choice of programming languages and data transfer protocols, object-oriented design applied to mapping, use of object-oriented pointers for efficient retrieval, interface definition language (idl) design choices, and factors associated with map display. Lessons learned throughout the design process will also be presented.

Sponsored by the Office of Naval Research/Marine Corps.

Presented at the Southern Conference On Computing, October 26-28, 2000.
Naval Research Laboratory Contribution Number NRL/PP/7440--00-1012.
Conference Proceedings

(Wilson)

GEOGRAPHICAL DATA INTERCHANGE USING XML-ENABLED TECHNOLOGY WITHIN THE GIDB™ SYSTEM

Wilson, R. McCreedy, F. Ladner, R. Olivier, D. Shaw, K.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004
Cobb, M.
University of Southern Mississippi
Hattiesburg, MS
Lovitt, T.
Planning Systems, Inc.
Slidell, LA
Petry, F.
Tulane University
New Orleans, LA
Abdelguerfi, M.
University of New Orleans
New Orleans, LA

Abstract

The Naval Research Laboratory has developed the Geospatial Information Database (GIDB™) System over the last eight years. The GIDB™ System was originally conceived as a completely object-oriented research prototype for mapping data. It has now matured into a complex multi-tiered system that provides geospatial data over the Internet. A key component of that system is a new, stable data model implemented in Java and the open source, all-Java, object-oriented database, Ozone. The GIDB™ System also includes the capability of accessing data from distributed, heterogeneous databases. A stable data model, along with the open standards of XML and XMI and resulting tools, provides a unique opportunity for expanding the architecture to a distributed system for heterogeneous data interchange. In this chapter we provide a case study of the design and development of an XML-based interchange architecture for the GIDB™ System. We give a case study example of how we interface with a meteorological data source using XML for data discovery and request. We also discuss our use of the Web Mapping Services (WMS) standard (de La Beaujardiere 2002) to retrieve data from other sources over the Internet. In addition, we show how an XML implementation known as the Geographic Markup Language (GML) can provide exchange and display information for geographic features in a heterogeneous environment.

Sponsored by the Office of Naval Research.

Published in the XML Book Edited by Akmal Chandhri in 2002 4th Quarter, Chapter 1, pp 1-21.
Naval Research Laboratory Contribution Number NRL/BC/7440--02-1002.
Book Chapter (Refereed)

(Wischow)

LOSSLESS IMAGE COMPRESSION WITH INTELLIGENT ALGORITHM SELECTION

Wischow, P.
Naval Research Laboratory
Stennis Space Center, MS 39529-5004

Abstract

Different digital image compression techniques yield different compression performance (space and time ratios) depending on the characteristics of the image to be compressed. Given a collection of images and a collection of compression algorithms, optimal overall compression performance is achieved by compressing each image with each algorithm then using the result, for each image, with the best compression ratio. While this 'brute force' approach yields optimal compression performance, it does so with considerable computational and storage overhead. As an alternative strategy, all images can be compressed using only one algorithm. This will yield good running time, but generally will result in sub-optimal compression ratios. The approach investigated in this study is to algorithmically pre-select for each image that compression technique, from a given set, that yields the best compression ratio. The pre-selection should be based on a defined, intrinsic characteristic of the image. This methodology would yield good running times provided the selection algorithm has a relatively low computational overhead.

In laser printers, the collated printing of multiple copies of multi-page documents requires page images to be cached. Since these images are very large, and the cache resource is limited, the images must be compressed efficiently. Thus, the selection of an appropriate compression technique is critical to low cost print controller designs. It is anticipated that due to the nature of printed pages (fonts, graphics, images) there exist some intrinsic characteristic that can be used as a selection criterion to determine the optimal compression technique.

Entropy was conjectured as a characteristic that could be used in an efficient heuristic that selects which of a collection of lossless compression algorithms (Huffman, Arithmetic, and LZW) will deliver the best compression performance for a given image. A framework was developed for the analysis of lossless compression algorithms and the evaluation of a selection algorithm that generally matches an image to the corresponding optimal compression algorithm. This research concludes that entropy is not a characteristic that could be used in a heuristic selector. However, further analysis suggests that a selection heuristic based on inherent visual geometrical properties of image files should be considered for further study.

Sponsored by the Naval Research Laboratory.

Published Thesis at the University of South Alabama, May 2001, Pages 1-72.
Journal Article (Refereed)

5. ACKNOWLEDGMENTS

This work was sponsored under Program Element 0603704N by the Oceanographer of the Navy via SPAWAR PMW 150, Captain Robert Clark, Program Manager; The Naval Research Laboratory Program Elements 0602435N and 0601153N, Dr. Herbert Eppert and Dr. Eric Hartwig, Program Managers; and the Office of Naval Research Program Element 0603345N, Dr. Linwood Vincent and Doug Todoroff Program Managers.